Illinois Coal Update

ILENR/CD 90/02

ENR Illinois Department of Energy and Natural Resources

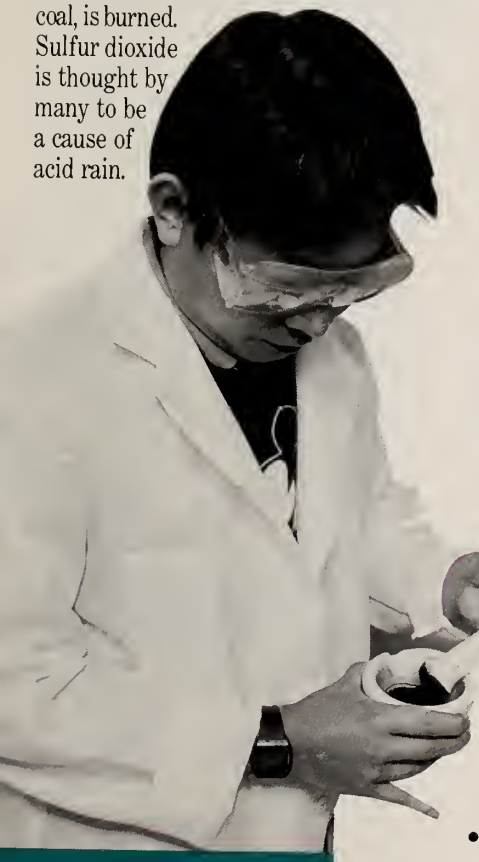
Volume 1, Number 1 Summer 1990

Publication of the Department of Energy and Natural Resources, Office of Coal Development and Marketing
Karen A. Witter, Director James R. Thompson, Governor

Illinois leads the nation in clean coal technologies

As America has entered the 1990s and looks toward the next century, Illinois is clearly the nation's leader in the research on commercial development of clean coal technologies (CCTs).

These new and improved technologies are designed to burn coal more efficiently and cost effectively, as well as to protect the environment from the effects of air pollution. The use of CCTs with coal-fired burners limits the amount of sulfur dioxide that is emitted into the air when high-sulfur coal, such as Illinois coal, is burned. Sulfur dioxide is thought by many to be a cause of acid rain.



Laboratory research on advanced clean coal projects requires coal sample preparation, which begins with fine grinding of Illinois coal.

The wide scale commercialization of CCTs could permit coal to assume a larger role in meeting America's future energy needs, while at the same time reducing sulfur dioxide emissions. Research and development of CCTs begin with analysis of the molecular structure of coal. Probing the basic organic nature of the fossil fuel helps scientists and researchers, and subsequently utility and industrial engineers, to understand how to make coal a fuel of the future.

Currently being researched and developed in Illinois are the following clean coal technologies:

- Flue gas desulfurization devices, commonly called scrubbers. These massive systems have been in use since 1970. Some older plants have installed scrubbers as well.

  Scrubbers are very effective. According to the U.S. Department of Energy, in the last 10 years sulfur dioxide emissions from coal-fired power plants have decreased 19 percent while coal use by these facilities has increased by 23 percent.

- A second-generation scrubber system, even more efficient and economical than conventional scrubbers. The system changes the polluting gases into salable gypsum and is being tested at the University of Illinois Abbott Power Plant.

- Fluidized bed combustion technology, now being demonstrated on an industrial scale. This process allows the burning of coal with limestone in an upward current of air, providing simple, economic pollution control and removal of nearly 90 percent of sulfur dioxide gases.

- Aggregate flotation. This process involves floating finely ground Illinois coal in water, in which the coal has been chemically conditioned to stick to rising air bubbles. Through this method nearly all of the inorganic sulfur sinks to the bottom of the mixing tank. A cleaner burning coal that emits less sulfur dioxide is the result.

A researcher investigates new uses for coal as a fuel.

The coal mining industry, around the country and in Illinois, has had a long-standing concern for protecting the environment. The industry traditionally has participated in the development of solutions to solve the ecological problems that occur when coal is mined and burned. Substantial efforts in research and development continue to provide for the efficient and effective—and clean—burning of coal as a viable energy source.

"Illinois is meeting the challenge of developing clean coal technologies to burn Illinois coal more cleanly, economically and efficiently."

Moving forward at Illinois Coal Development Park

The new Illinois Coal Development Park (ICDP), a cooperative effort between the Illinois Department of Energy and Natural Resources (ENR) and Southern Illinois University's Coal Research Center, serves as a focal point for the state's clean coal technology (CCT) research projects.

The ICDP, located near Carterville in Williamson County in southern Illinois, provides a site for state and coal industry-sponsored CCT research. It also is the home of the Center for Research on Sulfur in Coal (CRSC), which allocates state funds for the projects and is the largest state-supported program of coal research in the nation.

The park contains 25,000 square feet of office space in two buildings. The administration building houses research laboratories, the CRSC, the Department of Mines and Minerals Land Reclamation Office and the Illinois Geological Survey field office. The other building, a high-bay facility, is the home to the Southern Illinois University at Carbondale (SIU-C) dragline training program. Several small scale demonstration projects are also being developed at the facility.

Kim Underwood, Director of ENR's Office of Coal Development and Marketing, says, "The Illinois Coal Development Board has proposed plans for the park to become a national coal information and awareness clearing-house for people in the industry, as well as the general public, to obtain the information they need on coal."

Promising clean coal technologies could get their start in the park's labs, according to Underwood. "Projects begin in the lab as experiments with coal cleaning and coal combustion," he says. "As the projects advance, they may be scaled up to handle a larger work load.

"Presently, there are several clean coal technologies being developed and efforts are underway to begin two new projects," Underwood says. "Those two new projects include mild-gasification-circulating fluidized bed combustion and a coal-water-slurry combustor."

Coal: Energy of the future

by Kim Underwood
Director, Office of Coal Development and Marketing
Illinois Department of Energy and Natural Resources

To paraphrase Winston Churchill, this is coal's finest hour.

Kim Underwood

At first glance, many might question that statement. After all, we hear a litany of complaints these days directed at the high-sulfur coal produced in the state of Illinois, from environmentalists, from politicians... probably even from Madison Avenue advertising copywriters.

Curbing air pollution and drying up the sources of acid rain are all-American causes which deservedly should enjoy a bandwagon effect. The truth about Illinois coal, though, is that we're not joining the bandwagon. We're LEADING it, as we have for years.

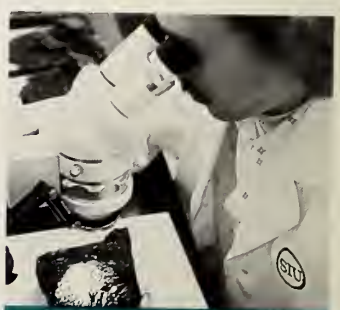
Illinois is in the vanguard of research on and development of "clean coal technologies" (CCTs). Before "acid rain" ever entered Webster's dictionary, the Illinois Department of Energy and Natural Resources was searching for cleaner, more efficient and less expensive ways to burn coal.

Of course, current legislation pending in Congress could have a severe impact on Illinois and its economy, particularly that portion directly and indirectly affected by its coal industry. A clean air bill, the first revision of the federal Clean Air Act of 1970 in 13 years, has passed the Senate and awaits action in the House, where leaders hope to submit their own bill to a vote.

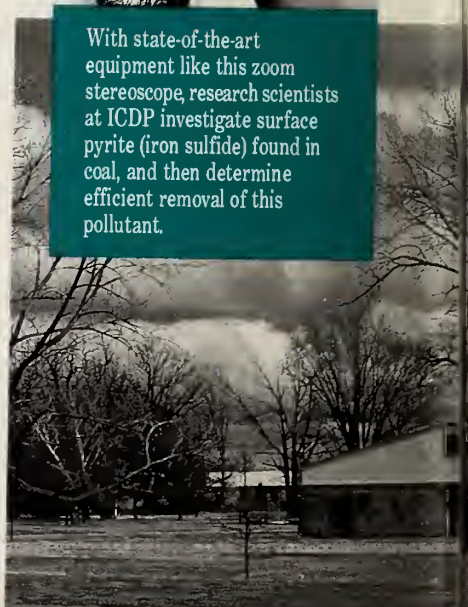
The Senate bill would require all power plants in the Midwest and Appalachia to cut their sulfur dioxide emissions by 10 million tons annually by the year 2000.

While that bill provides some incentives to utilities to buy CCTs that allow continued use of high-sulfur coal, the air pollution control bill that has been approved by the House Energy and Commerce Committee sounds far more reasonable to people like Bill Samuels, legislative director of the United Mine Workers, and Rep. Terry Bruce, D-Ill., a negotiator on the committee.

The House version would set up a "pollution allowance system" to help utilities pay for equipment—CCTs—to control emissions, and it would give



With state-of-the-art equipment like this zoom stereoscope, research scientists at ICDP investigate surface pyrite (iron sulfide) found in coal, and then determine efficient removal of this pollutant.



Coal research projects begin at the Illinois Coal Dev
The complex is located near Carterville.

"With 40 mines providing jobs for more than 12,000 men and women and creating nearly 25,000 spin-off jobs, coal has a major impact on the daily lives of many Illinois citizens."

more time for cleanup requirements. The pollution allowance system gives utilities more flexibility and provides incentives to install emissions cleaning devices, or scrubbers, to continue to use high-sulfur Illinois coal.

"Banking" of allowances would be allowed under this system, whereby a utility that decided to implement a CCT would have credits that could be sold, traded, kept or used to assist in cleanup of other plants. Such banking would not be permitted for utilities that switched over to western, or low-sulfur, coal.

Illinois coal will have a distinct advantage. The low transportation costs associated with Illinois coal, whether by water, rail or truck, are distinct advantages to customers far removed from the low-sulfur coal mines of Wyoming and other western sites.

With some 40 mines providing jobs for more than 12,000 men and women and creating nearly 25,000 spin-off jobs, coal has a major impact on the daily lives of many Illinois citizens. A total annual payroll of $500 million is pumped into the local Illinois economies of the state's mining areas.

Illinois Department of Energy and Natural Resources is meeting the challenge to develop clean coal technologies to burn Illinois coal more cleanly, economically and efficiently. Presently, Illinois research projects are coordinated by the state's Center for Research on Sulfur in Coal, headquartered at the new Illinois Coal Development Park at Carterville and supported by the Illinois Coal Development Board (ICDB).

To date, the Board has allocated nearly $20 million for laboratory research, as well as authorizing nearly $115 million in bond funds for research and development and demonstration projects.

So, just as Churchill's England was underestimated by its adversaries during World War II, those who are sounding the death knell of the Illinois coal industry obviously haven't been paying attention. Illinois coal—clean, efficient and effective—is ready to meet, and exceed, the various and complex demands of the future. You can count on it.

nt Park, a 25,000-square-foot complex consisting of office space and state-of-the-art laboratories.

Exill markets Illinois coal to foreign buyers

Coal produced in Illinois mines long has gone to heat homes, fuel factories and utilities across the Midwest and Southeast. Now a new program, certified by the U.S. Department of Commerce, is trying to find buyers of Illinois coal for foreign consumption.

EXILL, an export trading company that is a not-for-profit division of the Illinois World Trade Center (IWTC), has started a new operation to help find buyers for Illinois coal abroad. EXILL's international coal marketing initiative was funded by the Illinois Coal Development Board through the Illinois Department of Energy and Natural Resources (ENR).

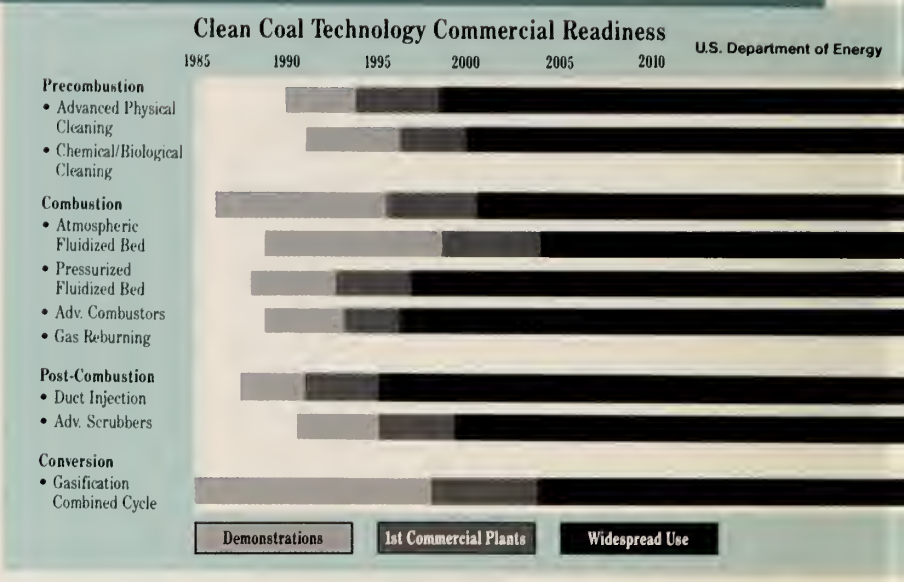
Roy Kaelin, EXILL's international trade manager, says that EXILL's operation has three goals.

"Our first goal is to let Illinois coal producers and other potential exporters know that help is available to find overseas markets for their products through EXILL," he says. "Secondly, we work at locating and developing leads for buyers of Illinois coal overseas. And third, we coordinate the international transactions that come from these leads."

EXILL's coal operation is focusing its efforts on the heavily industrialized countries of western Europe and eastern Asia, since they're the most likely consumers of Illinois coal, an excellent boiler fuel. In addition, EXILL experts are currently studying the market for Illinois coal and compatible coal burning technologies for use in eastern Europe.

"One of the primary goals of the state's coal industry is cleaner air for everyone, and removing the sulfur from Illinois coal helps lead to cleaner air."

New markets, technologies are keys to coal's future



Marketers will tell you that the way to build business is to find new market areas while further developing existing ones. That strategy is sound advice, whether you're selling shoes, sockets—or coal.

The Office of Coal Development and Marketing (OCDM), part of the Illinois Department of Energy and Natural Resources (ENR), works to actively promote new uses for Illinois coal with existing customers, as well as looking for new clientele to add to the list of buyers

Funding basic and applied research to foster the advancement of clean coal technologies to burn high-sulfur Illinois coal is one of the essential purposes of ENR. The department works within guidelines established by the Illinois Coal Development Board, a panel of legislative, business, scientific and utility representatives that was established to help set the coal research agenda for Illinois.

Since 1981, more than $20 million in state funds have been spent on laboratory research to find and perfect clean coal technologies which hopefully one day will open Illinois coal to more expansive usage, both in the state and throughout the world. Private funds from the Illinois coal industry have added another $1 million to this research program.

Beyond the initial research funds, a roster of 17 technology demonstration projects, including advanced utility power and industrial scale systems, have received nearly $115 million in state financial assistance.

To further expand the customer base for Illinois coal, the Illinois General Assembly created the Illinois Industrial Coal Utilization Program, which offers low-interest loans to industries that consider converting from oil or natural gas consumption to a utility system which utilizes coal. Under this effort, each qualifying industrial facility can receive up to $2.5 million in low-interest loans.

OCDM manages the Illinois Coordinated Review Process, a voluntary governmental program that assists in guiding major energy-developing projects throughout the complex permitting process.

CCTs up close: A look at aggregate flotation

One of the most promising processes being developed in Illinois is aggregate flotation. This CCT, currently being tested at the Illinois State Geological Survey in Champaign, removes 80 percent to 90 percent of all ash and pyrite from most Illinois coal. On the other hand, aggregate flotation retains more than 80 percent of the heating value (Btu) in the coal by using less reagent—that is, surfacantes, alcohols and kerosene—than other processes.

Gus Ruch, Assistant Branch Chief of Mineral Resources and Engineering Branch at the Illinois Geological Survey, believes that aggregate flotation is a promising coal cleaning method. "Aggregate flotation is an improvement over present commercially used physical coal cleaning methods," says Ruch. "This method is an effective cleaning method; it increases efficiency, improves grade, can be used in conjunction with other current CCT methods and has the potential to reduce cost.

Pyrite and other mineral matter in Illinois coal tend to occur as fine-grained particles, which require extensive grinding to separate the coal from the pyrite. Initial research and development overseen by the Center for Research on Sulfur in Coal (CRSC) in Carterville yielded valuable information about the process.

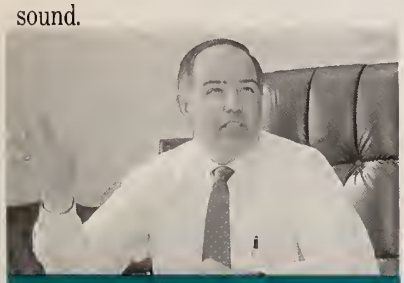
It was found that by floating finely ground Illinois coal in water, in which the coal has been chemically conditioned to stick to rising bubbles, nearly all of the inorganic sulfur remains in suspension in the mixing tank. The result is a cleaner burning coal that emits less sulfur dioxide.

Research for aggregate flotation has been funded to date by the Illinois Department of Energy and Natural Resources, with administration of the funding coordinated by the Illinois Coal Development Board.

"Some of the most promising clean coal technologies are capable of removing up to 95 percent of the sulfur dioxide emissions."

An expert discusses new clean coal technologies

Illinois high-sulfur coal can be utilized as a safe, reliable energy source and, with clean coal technologies (CCTs), it can be environmentally acceptable. John Wootten, vice president of research and technology at Peabody Holding Company, provides his views on the wide range of CCTs which are both cost-effective and environmentally sound.



"The high sulfur coal markets have the potential to remain intact."

Q. *What do you believe are some of the most promising clean coal technologies being developed, in terms of effectiveness and cost efficiency?*

A. The most promising and cost-effective CCT is the furnace sorbent injection process, which removes 50 percent to 70 percent of the sulfur dioxide by injecting an absorbing compound (sorbent) into the high temperature region of the furnace where combustion occurs. Sorbent injection is most economical for older existing facilities because it can be retrofitted easily.

Another effective CCT is atmospheric fluidized bed combustion (AFBC). This technology is capable of reducing sulfur dioxide emissions by 85 percent to 90 percent, with moderate nitrogen oxide reduction. This process begins with feeding crushed coal into a bed of limestone.

In terms of long-term alternatives, pressurized fluidized bed combustion (PFBC) is capable of reducing sulfur dioxide emissions by 90 percent to 95 percent. PFBC is similar to AFBC except the bed is pressurized up to 16 times the atmospheric pressure.

In addition, the integrated gasification combined cycle technology also could be promising with advancements in research. In this process coal is turned into a gaseous fuel before combustion by exposing it to a small amount of oxygen under high pressure and a hot temperature. Sulfur dioxide emissions are reduced 95 percent to 99 percent with moderate nitrogen oxide emission reduction.

"Developing CCT projects within an acceptable range of technical and financial risks is the most important aspect of developing CCTs faster."

Q. *With pressure on to enact clean air regulations and comply with strict deadlines within a few years, is CCT development simply too late to save markets for higher-sulfur coal?*

A. If the projects in the first three phases of the CCT program selected by the government remain on schedule, the high-sulfur coal markets have the potential to remain intact. If the contracts for Clean Coal Round Three close this year, then all the clean coal projects can be put into place, allowing retrofit technologies to be available within the next couple years.

Q. *Do you think scrubber technologies will be developed to the point of being more cost-effective for older plants?*

A. Scrubber technology, which is a device that removes sulfur dioxide from flue gas before it flows up the stack, is advancing. However, the feasibility of using a scrubber depends on the age of the industrial plant. An older plant may not be economically viable for scrubber technology because its cost may require more capital than the original plant merits.

Q. *Do you think the demand for Illinois' high-sulfur coal will increase, decrease or remain at the same level?*

A. The demand for Illinois high-sulfur coal will remain steady beyond the year 2000 in regions where there is a transportational advantage. Even though Illinois basin coal contains approximately 3 percent sulfur after washing, it still remains at an environmental disadvantage because of additional cost to remove the sulfur.

"The demand for Illinois high sulfur coal will remain steady beyond the year 2000."

Q. *Is it possible to develop CCTs more quickly?*

A. The entire process of developing CCTs is very complex and requires extensive research. Everyone, including the coal users and the coal industry, continues to drive the process faster. I believe developing CCT projects within an acceptable range of technical and financial risks is the most important aspect of developing CCTs faster.

Office of Coal Development and Marketing
Illinois Department of Energy and Natural Resources
325 W. Adams, Room 300
Springfield, IL 62704-1892

Illinois Coal

Update

ENR
Illinois Department of Energy and Natural Resources

Publication of the Department of Energy and Natural Resources, Office of Coal Development and Marketing
Karen A. Witter, Director James R. Thompson, Governor

Printed by Authority of the State of Illinois.
Printed on recycled paper.

ILENR/CD-90/02(90-2)

Illinois Coal Update

Illinois Department of Energy and Natural Resources

Volume 1, Number 2 Fall 1990

Office of Coal Development and Marketing

Karen A. Witter, Director; James R. Thompson, Governor

Coal Awareness Week Lauds Key State Industry

An industry that provides the livelihood for 13,000 people and stokes the fires of the Illinois state economy by $1.5 billion annually is cause for celebration. That was the case when Illinois proclaimed October 21-27, 1990, as Coal Awareness Week.

To recognize what advancements in technology are being made to burn coal more cleanly, the state held a variety of events to draw attention to the fact that coal has been, is and can continue to be a significant part of the Illinois economy.

A key element of Coal Awareness Week was the formal dedication on October 23 of the Illinois Coal Development Park, located in southern Illinois near Carterville. Illinois Department of Energy and Natural Resources (ENR) and elected officials, executives from Southern Illinois University (SIU) and coal researchers joined industry representatives in a public ceremony to recognize the facility as the symbol of Illinois' commitment to coal.

In dedicating the park, a time capsule titled "Illinois Treasure" was buried, containing articles related to the history of coal and clean coal technologies in the state.

Coal has had a major impact on the economy of Illinois since the fossil fuel was first commercially mined in Illinois' Jackson County around 1810. Today, Illinois ranks fifth among all states in coal production, with more than 60 million tons mined annually. Illinois' reserves of bituminous coal — the most widely used coal in the country — are the largest reported in any state.

For nearly two centuries, coal has provided energy to run Illinois farms, produced steam and electricity to drive large agricultural and commercial industry plants, and provided heat for utilities to help consumers combat the cold winds of winter.

The 40 coal mines in Illinois provide jobs for 13,000 men and women, and also spin off another 25,000 jobs, creating an annual coal-related payroll of $500 million. The resultant economic impact of that payroll is a substantial $1.5 billion to the sometimes fragile economies of many towns primarily located in the southern half of the state.

During Coal Awareness Week, the Coal Development Park was the site of tours, field trips by local students, essay contests, audio-visual presentations and exhibits of mining equipment and clean coal technologies.

"Coal Awareness Week provided the opportunity for us to showcase the importance of coal to Illinois," said Karen A. Witter, director of the Illinois Department of Energy and Natural Resources. "A visit to the park provides a look at our nation's energy future."

More than 200 people gathered to salute the coal industry and take part in the time capsule ceremony at the Illinois Coal Development Park.

John Mead, director of the Illinois Coal Research Center, addresses the future of coal during Coal Awareness Week.

The Coal Development Park is a cooperative effort between ENR and the SIU Coal Research Center. It is designed to be a national coal information clearinghouse for the industry and the general public.

In addition to serving as the home of the SIU dragline training program, the park also houses research laboratories, ENR's Center for Research on Sulfur in Coal, the Illinois Department of Mines and Minerals Land Reclamation Office, and a field office for the Illinois State Geological Survey.

In an official proclamation for Coal Awareness Week, Governor James R. Thompson encouraged all residents of Illinois to acknowledge the importance of coal to the state and its "pivotal role in the history and development of Illinois as a vital social, industrial and economic power." ✦

"We need to increase public awareness of the intrinsic value of coal to this state as a clean, inexpensive and proven source of energy."

Awareness Surfacing for Illinois Coal

By Kim Underwood
Director, Office of Coal Development and Marketing, Illinois Department of Energy and Natural Resources

You've heard the story about the individual who keeps a light under a bushel basket. Despite the bright shining of the light, no one sees it, and therefore it has minimal value. That's the problem we are working to avoid for the coal industry in Illinois. If the bright light of progress cannot penetrate the basket of apathy, indifference, and lack of awareness that threaten to dim its great promise, the state's potential for a thriving coal industry upon entering the 21st century could burn out altogether.


Kim Underwood

That may be an exaggeration, but the message is as clear as that bright light: We need to increase public awareness of the intrinsic value of coal to this state as a clean, inexpensive and proven source of energy.

Elsewhere in these pages you've read about Coal Awareness Week, which took place throughout Illinois from October 21 through 27. It was fun for many of us to get together and tell the modern Illinois coal story to the media, to the consumers and to the utilities throughout Illinois and in neighboring states.

We even buried an "Illinois Treasure," a time capsule of articles related to the history of coal and clean coal technologies in the Prairie State, at the new Illinois Coal Development Park at Carterville.

Who knows? Centuries from now, that capsule may be unearthed and reveal to curious scientists the beginnings of the advanced CCTs that provide the world of the 22nd century with an abundance of clean, reliable fuel for the energy needs of that future society.

It's an exciting story to tell. The invasion of Kuwait by Iraq in early August brought the reality of oil shortages front and center once again to the American public, a reality we had increasingly ignored since the Arab oil embargo of 1973.

And while there are concerns about coal, we're answering those concerns at the same time that other sources of energy — oil, nuclear, natural gas — are grappling with their own problems.

Coal awareness is an ongoing campaign that we intend to promote with residents and companies alike. We intend to get across the message that Illinois is leading the nation in the development of clean coal technologies, as evidenced by CCTs already in operation at places such as the University of Illinois in Champaign and Archer Daniels Midland Company in Decatur (see related story).

We intend to continue to develop research projects for CCTs at the Illinois Coal Development Park, projects coordinated by the state's Center for Research on Sulfur in Coal and supported by the Illinois Coal Development Board. We look forward to more demonstration projects of CCTs that will provide even more effective ways to cleanse Illinois' abundant bituminous coal resources of its high sulfur content.

And while strict new revisions to the Clean Air Act are slowly put into action by Congress, Illinois is many steps ahead in complying with the intent of that legislation. At the same time, the report from the 10-year, $500 million study by the National Acid Precipitation Assessment Program has found no conclusive evidence that power plants using high-sulfur coal increase the so-called phenomenon known as acid rain. For more on that, check out our interview with noted scientist Ed Krug in this issue.

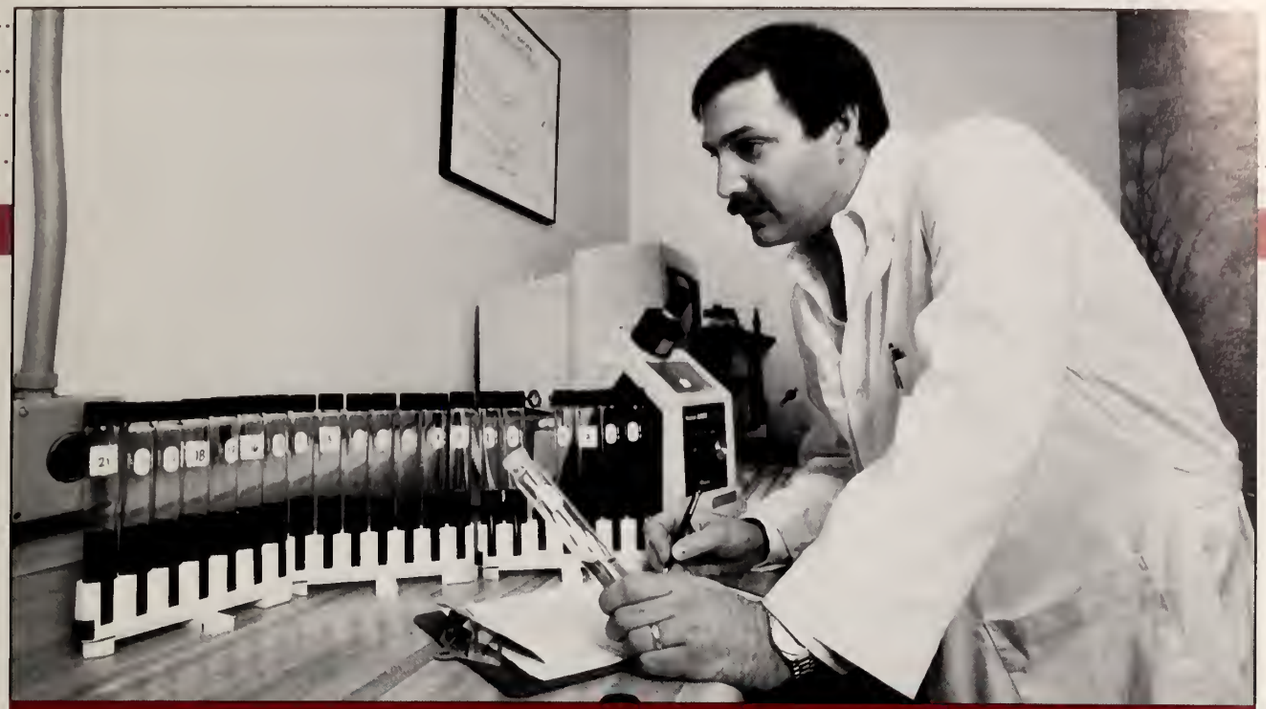
Coal awareness. Those of us at the Illinois Department of Energy and Natural Resources' Office of Coal Development and Marketing know that Illinois has the resources and the technology to provide a clean, inexpensive and highly reliable energy source for centuries to come.

We're taking that message not only to the people and businesses of our state, but also to markets around the country and the world, because coal can be a bright light for Illinois. ✦

Technology Up Close: Circulating Fluidized Bed Combustion

(Each quarter, the "Illinois Coal Update" focuses on a different clean coal technology. Funding for 16 CCT projects in Illinois since 1974 has been provided by the Illinois Coal Development Board, as well as private parties and the U.S. Department of Energy. These development and demonstration programs are administered by the Illinois Department of Energy and Natural Resources.)

Because Illinois has a large supply of high-sulfur coal, it is important to find an effective method to remove sulfur from power plant emissions. Among the many clean coal technologies currently being tested in Illinois is a process known as circulating fluidized bed combustion (CFBC). Like other fluidized bed combustion (FBC) processes, this system removes sulfur from coal during combustion.



Researcher Bill Huggett at the Illinois Coal Development Park in Carterville, Ill., monitors a coal mixture experiment. The lab's grating centrifugation system divides coal into its basic components for analysis. The coal research facility was dedicated in late October, during Coal Awareness Week in Illinois. Researchers at the Park develop technologies to burn coal more cleanly and efficiently.

CCT Shows Promise at Hennepin

An innovative new clean coal technology (CCT) that reduces noxious emissions and produces essentially the same energy is being tested at the Illinois Power Company's Hennepin Station in the northern Illinois community of Hennepin.

FBC technology is based on the concept of burning coal in a bed of sorbent material, such as limestone, in the boiler. An upward current of air causes the bed to behave like a boiling liquid.

This technology provides effective control of sulfur dioxide, removing 90 percent of sulfur in combustion gases when limestone is added to the combustion chamber. The low combustion temperature also inhibits the production of another pollutant, nitrogen oxide.

One CFBC operation currently in use is the Keeler/Dorr-Oliver system at the Archer Daniels Midland Company (ADM) in Decatur. It is the largest CFBC industrial cogeneration plant in the world.

What specific steps does the CFBC variation follow? First, crushed coal and limestone are injected into feeder boilers, which control their flow. The limestone feed rate is regulated so that 90 percent of sulfur dioxide emissions are captured at all times. Fluidizing activity causes coal and limestone to mix as they fall by gravity into the bed. As solid particles mix, calcium in limestone captures sulfur in coal and forms calcium sulfate.

Second, preheated air is introduced through a water-walled high pressure air chamber. The air is forced into the combustion chamber through holes in the distributor plate on which the coal and limestone mixture rests. The preheated air moves vertically through the crushed coal/limestone combination at 18 to 20 feet per second, suspending solid particles and causing them to circulate.

Then, preheated secondary air is introduced into the system at two elevations. This causes coal to burn slowly without releasing nitrogen oxide, while ensuring that the fuel receives enough air to burn completely.

Two overbed gas start-up burners are located on each side wall. As coal in the bubbling mixture burns, it creates heat that warms the bed and in turn evaporates water in the tube walls of the combustion chamber.

Flue gases from each boiler then pass through two 1,600-degree Fahrenheit cyclone separators. Solids collected by each separator are recirculated to the combustion chamber through two fluidized solid recirculation systems. Flue gases leaving the cyclones pass over a superheater, which cools the gas and in turn heats steam from the evaporation point to the temperature necessary to run turbines.

Archer Daniels Midland Company, Decatur, Ill., replaced natural gas boilers and electricity energy sources with coal-fired Keeler/Dorr-Oliver circulating fluidized bed boilers. The new technology reduced cost and increased output by 30 to 50 percent.

Ash is removed from four locations in the apparatus and flows into two different ash classifiers. These areas then use combustion air to separate the wastes from unburned coal particles, which are recirculated to the boiler. Fine ash is removed from the other locations via standard hoppers.

The dry, granular waste has potential use as a soil nutrient, as an aggregate in concrete or asphalt, as an ingredient in surfacing and paving, and as filler for surface-mined land reclamation.

Circulating fluidized bed combustion technology could provide answers to numerous problems faced by the coal industry. Aging coal-fired utility boilers facing modernization in the next decade will be subject to new Clean Air Act regulations.

Current regulations require that new or repowered coal plants install equipment capable of burning all grades of fuel without posing a threat to the environment. Since CFBC meets this criterion, documentation of successful demonstrations of the technology on a commercial scale, such as at ADM, could ensure a long-term market for Illinois coal. ✦

"Gas reburning-sorbent injection is a retrofit technology with application to all types of existing coal-fired utility boilers."

CCT Shows Promise at Hennepin

An innovative new clean coal technology (CCT) that reduces noxious emissions and produces essentially the same energy is being tested at the Illinois Power Company's Hennepin Station in the northern Illinois community of Hennepin.

The gas reburning-sorbent injection (GR-SI) technology demonstration has entered its final phase at the Hennepin site. Thus far, the GR-SI technology demonstrates the capability to remove 60 percent of nitrogen oxide and 50 percent of sulfur dioxide from coal-burning emissions at the Hennepin Station.

Beyond its ability to cut down on air pollutants, the GR-SI technology has another advantage as well. Aric D. Diericx, supervisor of air quality at Illinois Power, says that the GR-SI technology actually uses just 80 percent to 85 percent of coal normally consumed by the power plant's boilers.

Following another 12 months of testing, the plant should be fully operating with the GR-SI technology, according to Dr. William Bartok, senior vice president and project director of Energy and Environmental Research Corporation, which designed the system.

The GR-SI device was installed to a conventional coal-burning boiler at the plant to help reduce sulfur dioxide and nitrogen oxide emissions in a cost-effective manner. GR-SI is a retrofit technology with application to all types of existing coal-fired utility boilers.

With the new restrictions put on Midwestern power plants by the revised Clean Air Act of 1990, many plants that burn high-sulfur coal will need to utilize CCTs such as the GR-SI technology to comply with federal regulations. Operational costs for new equipment are often a factor in such considerations. Bartok says that the GR-SI technology, in particular, "is cost-effective, and it is applicable to existing smaller units with relatively low capacity factors."

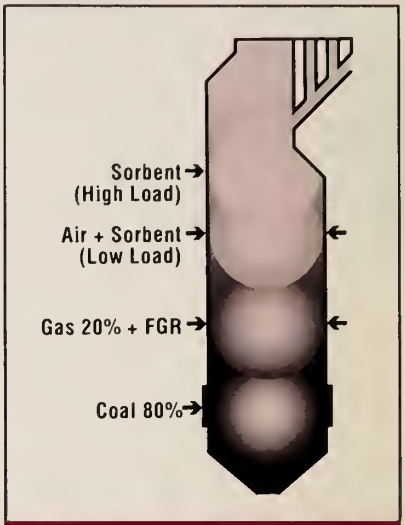
The GR-SI technology demonstration is a $30 million project funded by the Illinois Department of Energy and Natural Resources, U.S. Department of Energy, Pittsburgh Energy Technology Center and the Gas Research Institute.

Technically, the process works by reburning gas to reduce nitrogen oxides, while a hydrated lime sorbent is injected to reduce sulfur dioxide. In reburning, coal is burned in the main heat release zone of the boiler, and then natural gas is injected above the main zone to reduce nitrogen oxide emission. The reburning process converts nitrogen oxide to elemental nitrogen, which is not harmful to the environment. The gas reburning is completed with the addition of heat further up in the boiler furnace.

In addition, calcium-based or hydrated lime sorbents are injected at a level in the boiler where the temperature provides maximum capture of sulfur.

Nitrogen oxide and sulfur dioxide are thus reduced, leaving only fly ash and sorbent. These residues are then collected; at present, research is underway in Illinois to find ways to reuse these elements as pavement resurfacing material.

Research continues on a number of wide-ranging CCTs in Illinois. With results such as those demonstrated to date at the Illinois Power Company's Hennepin Station, the state's Office of Coal Development and Marketing is encouraged that a broader variety of effective CCTs will soon be added to the number of systems already in use. ✦



The new gas reburning-sorbent injection (GR-SI) technology, demonstrated at the Illinois Company's Hennepin Station, removes 60 percent of nitrogen oxide and 50 percent of sulfur dioxide from emissions.

superheater, which cools the gas and in turn heats steam from the evaporation point to the temperature necessary to run turbines.

Ash is removed from four locations in the apparatus and flows into two different ash classifiers. These areas then use combustion air to separate the wastes from unburned coal particles, which are recirculated to the boiler. Fine ash is removed from the other locations via standard hoppers.

The dry, granular waste has potential use as a soil nutrient, as an aggregate in concrete or asphalt, as an ingredient in surfacing and paving, and as filler for surface-mined land reclamation.

Circulating fluidized bed combustion technology could provide answers to numerous problems faced by the coal industry. Aging coal-fired utility boilers facing modernization in the next decade will be subject to new Clean Air Act regulations.

Current regulations require that new or repowered coal plants install equipment capable of burning all grades of fuel without posing a threat to the environment. Since CFBC meets this criterion, documentation of successful demonstrations of the technology on a commercial scale, such as at ADM, could ensure a long-term market for Illinois coal. ✦

"Our research has not been able to quantify a direct correlation between Midwestern power plants and acid rain."

Coal and Acid Rain: An Expert View

(What exactly is the correlation between acid rain and the burning of fossil fuels such as coal? Dr. Edward Krug, a former associate scientist at the Illinois State Water Survey in Champaign, researched the acid rain phenomenon for Connecticut from 1980-85 and then for the National Acid Precipitation Assessment Program (NAPAP) while at the Illinois State Water Survey from 1985-90. He was the featured speaker at the 98th annual meeting of the Illinois Mining Institute in September.)

Q. *What is acid rain?*

A. Acid rain is created by the combustion of fossil biomass. This biomass contains carbon, nitrogen and sulfur, which convert to gas upon burning. When the gas combines with atmospheric water, it forms carbonic, nitric and sulfuric acid. Carbonic acid and nitric acid are natural fertilizers for both plants and trees, and both of these acids are absorbed as natural nutrients. Sulfuric acid/sulfate is also a nutrient to trees and plants; however, more sulfur is emitted than is needed by plants. This excess sulfate is detected in forests, soils and waters in remote areas.

Q. *How much acid rain is found in the northeastern United States and in Canada as a result of sulfur emissions from Midwestern power plants?*

A. Our research has not been able to quantify a direct correlation between Midwestern power plants and acid rain. We do know that precipitation in much of eastern North America is unnaturally acidic. However, the average acidity of precipitation in the Northeast is pH 4.3. This amounts to only about 20 pounds of acid in 9.1 million pounds of water that fall on an acre of land in the Northeast every year. Acid rain in Nova Scotia is only one-third acidity of that in the Northeast.

Q. *How extensive is the problem?*

A. Acid rain is falling on 300 million acres of forest in the eastern United States. It may be a contributing stress to high-altitude spruce/fir forests, which live in a naturally hostile environment. These forests are commonly bathed in a cloud of water 10 times more acidic than rain falling at lower elevations. High-altitude spruce/fir forests account for 0.1 percent of all Eastern forests.

Acid rain has no effect on managed agricultural soils. Northeastern farmers use enough lime sorbent to neutralize 4,000 pounds of soil acidity per acre per year. Unmanaged Northeastern forest soils, on the other hand, typically have 1,000-to-1 million times the acidity of pH 4.3 acid rain. If acid rain has an effect on these soils, it is a subtle one.

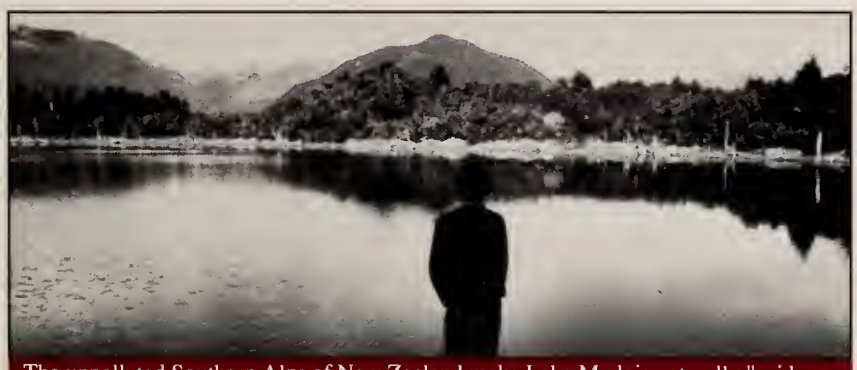
Dr. Edward Krug, a former associate scientist at the Illinois State Water Survey in Champaign, Illinois.

Q. *Does acid rain cause acid lakes?*

A. The chemistry of the vast majority of lakes is controlled by alkalinity produced by mineral weathering of lime-like substances. Acid rain does not affect these lakes. Acid lakes occur where highly acidic peaty soils and acid-producing vegetation such as sphagmum mosses naturally acidify water. For example, 28 to 79 percent of lakes and streams in areas of Australia and New Zealand are acidic in the absence of acid rain. The recent NAPAP study—a 10-year, $500 million federal effort to investigate and assess the acid rain phenomenon—revealed that those lakes which are acidic have been that way for most of history.

Q. *Would it help to cut sulfur emissions?*

A. It will definitely help to reduce sulfur emissions for reduction of acid rain. Levels of acid rain have been reduced 30 percent since the Clean Air Act was enacted in the '70s. Without Clean Air legislation there would have been 40 million tons of sulfur emitted into the air this year. ✦



The unpolluted Southern Alps of New Zealand make Lake Mudgie naturally "acid-dead," due to the lack of a natural buffering system. A total of 3.5 percent of the lakes in the sensitive areas of the eastern United States receiving acid rain are "acid dead."

Illinois Department of Energy and Natural Resources
Office of Coal Development and Marketing
323 W. Adams, Room 300
Springfield, IL 62704-1892

Illinois Coal Update

Illinois Department of Energy and Natural Resources

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing Karen A. Witter, Director; James R. Thompson, Governor

- **Illinois Salutes Coal Industry/Clean Coal Technologies in Coal Awareness Week**
  Given the impact of new Clean Air legislation, can the coal industry in Illinois continue to provide jobs for 13,000 people, while supplying the state economy with $1.5 billion annually?

- **New Clean Coal Technologies Meet Government Clean Air Regulations**
  Views of advanced CCTs such as circulating fluidized bed combustion and gas reburning-sorbent injection.

- **Coal Burns and Acid Rain Falls– Is There a Correlation?**
  Dr. Edward Krug answers questions about the correlation between acid rain and the burning of fossil fuels such as coal.

Printed by Authority of the State of Illinois.
Printed on recycled paper.

Illinois Coal Update

ILENR/CD 90/02(91 1)

ENR Illinois Department of Energy and Natural Resources

Volume 2, Number 3 Spring 1991

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing, John S. Moore, Director; Jim Edgar, Governor

NAPAP Report Puts Acid Rain in Perspective

The most comprehensive scientific study ever undertaken by the federal government has been completed, but its results have been largely ignored.

That's part of the puzzling picture regarding the National Acid Precipitation Assessment Program (NAPAP), which finished a decade of study in late 1990. Involved in the work on acid rain were 10 years of analysis and research undertaken by more than 3,000 scientists, at a cost of $570 million.

As James R. Mahoney, director of the NAPAP study, said in his report on the program, "Forest response studies have reduced some of the worst fears about possible effects of acidic deposition at the levels found in North America. In general, surveys indicate that the majority of North American forests are healthy."

Mahoney said that "no regional patterns of adverse effects on crop growth and production have been identified, related to acidic deposition." What the study did find is that acid rain does contribute to the "corrosion of metals and deterioration of stone in buildings, statues and other cultural resources."

Curiously, though, the national media have largely chosen to ignore the NAPAP study. A notable exception is CBS-TV's weekly investigative series, "60 Minutes," which focused on NAPAP's work in a December 30, 1990, story (see an abridged version of that report elsewhere in this newsletter).

The NAPAP study did indicate that "acidic cloud water can reduce the cold tolerance of red spruce at high elevations in the eastern United States and thereby increase its susceptibility to winter injury." However, Mahoney said that the number of acidic lakes in the eastern part of the nation is about the same now as it was in 1980.

The NAPAP study indicates that fears about the destructive force of acid rain are exaggerated. As power plants move to comply with the reduction requirements necessary by 1995, the effects of acid rain, already proven to be less than previously supposed, will decrease even further.

Furthermore, the national emission rates of sulfur dioxide, nitrogen oxide and volatile organic compounds have already declined by 6 percent to 20 percent from 1975 to 1988.

NAPAP's work also addressed the importance of clean coal technologies being researched, tested and demonstrated in several states, including Illinois, pointing out that "a range of control measures to reduce sulfur dioxide emissions is currently available, and several advanced technologies (now in or entering the commercial demonstration phase) offer the prospect of better energy efficiency (and therefore less carbon dioxide emissions)."

According to Mahoney's statement, the majority of the NAPAP budget focused on three principal areas: atmospheric processes and measurements, aquatic effects and terrestrial (forestry and crops) effects. Six federal agencies, including the Environmental Protection Agency, the Department of the Interior, the Department of Energy, the National Oceanic and Atmospheric Administration, the Council on Environmental Quality, and the Department of Agriculture led the effort.

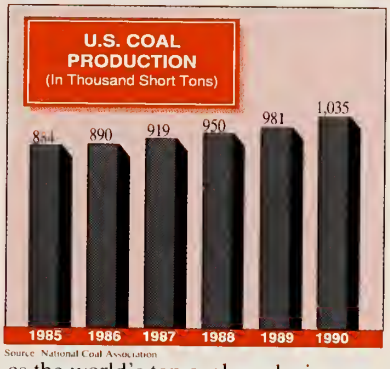
A key element of the NAPAP work was to develop a state-of-the-art Regional Acid Deposition Model (RADM) by incorporating the results of the specialized atmospheric studies conducted in the NAPAP study. Mahoney envisions that RADM will be used in the future for regulatory management studies on state, regional and national levels.

In summarizing, Mahoney noted that "the NAPAP studies have significantly reduced the scientific uncertainties about acidic deposition processes and effects. More extreme views expressed by some individual scientists and in some of the media have been rendered unlikely to be correct." ✦

U.S. Coal Production Passes Record Billion Mark

Coal production in the United States eclipsed the 1 billion ton mark for the first time in 1990.

A total of 1.035 billion tons of coal was produced, exceeding the 979.5 million tons produced in 1989, according to the National Coal Association. The nation maintained its rank as the world's top coal-producing country.



Source: National Coal Association

Production in Illinois was 60.3 million tons (mt) of coal, surpassing the 59.7 mt mined in the state in 1989. Other top coal-producing states in 1990 were Wyoming, Kentucky, West Virginia and Pennsylvania.

"The state of Illinois is working aggressively to help the coal industry maintain momentum," said John S. Moore, director of the Illinois Department of Energy and Natural Resources. "Although mandates of the 1990 revisions to the federal Clean Air Act could reduce coal production in Illinois in the short term by as much as 30 percent, the clean coal technologies being tested and demonstrated in Illinois will help the state in the future in both the national and international marketplaces." ✦

"Illinois is the recognized leader in the research, testing and development of clean coal technologies."

Coal: After the Clean Air Act

By Kim Underwood, Director, Office of Coal Development and Marketing Illinois Department of Energy and Natural Resources

Long before the ink dried in 1990 on revisions to the federal Clean Air Act, the State of Illinois was looking down the road and planning for the future. To those of us in Illinois' Department of Energy and Natural Resources, shaping the future of coal and protecting our environment are inter-related objectives.


Kim Underwood

The fight for coal has not been, and will not be, an easy one. Many perceptions remain about sulfur dioxide emissions causing extensive damage from acid rain, despite the fact that the most comprehensive scientific study ever undertaken by the federal government found no appreciable escalation in the number of acidic lakes in the Northeast, a fact in contrast to popular opinion.

Instead, the results of the National Acid Precipitation Assessment Program (NAPAP) were largely ignored by the media, with the exception of CBS-TV's "60 Minutes."

It is likely, too, as a recent BBC documentary attested, that the public's fears about global warming will turn out to be overblown and exaggerated. What matters now, though, is the public perception of global warming as an imminent and serious threat to our environment.

It's ironic, then, that coal has been made the fall guy for much of the ecological concerns of the past 20 years. In reality, Illinois is the recognized leader in the research, testing and development of clean coal technologies (CCTs) that offer the most practical and environmentally sound solution to our current and projected energy needs.

There are now proven CCTs that enable a coal-burning power plant to scrub the sulfur content to well below standards established by the Clean Air Act. Sulfur content in high-sulfur, bituminous coal mined in Illinois can be scrubbed to as low as 0.3 pounds per million Btu's, well below the 1.2 pounds per million Btu's required by the Clean Air Act by the year 2000.

For example, the flue gas desulfurization device known as the Chiyoda Thoroughbred (CT-121) scrubber installed at the University of Illinois' Abbott power plant in Champaign was one of six plants nationwide honored by POWER Magazine in October 1990 with its Power Plant Award. POWER stated that the chosen facilities represent "leadership in the application of fresh ideas and new technology and equipment to minimize environmental impact and maximize efficiency."

That CT-121 unit is also now in use at a Georgia Power Company 100-megawatt power plant. For the 110 power plants, mostly in the Midwest, that have been targeted for emission reductions by 1995, CCTs such as the CT-121 unit offer environmentally sound solutions that are also effective and, in the long run, cost-efficient.

It is a fact that 57 percent of the nation's electricity is generated by coal. Certainly for the next 20 years the country will continue to derive more than half its electricity from coal-burning power plants. To satisfy that demand, and to directly answer questions posed by environmentalists and politicians from California, New York, Wyoming and other areas, it is paramount that the leaders of our industry start thinking in unison to accomplish common goals.

The National Coal Association, the United Mine Workers and all of us associated with the coal industry need to band together now to let the world know what we have to offer. Coal is, after all, the once and future energy source: Abundant enough to meet the world's energy needs for the next several decades, while also capable of protecting our environment.

We can produce results. After all, Illinois has already reduced sulfur dioxide emissions nearly 30 percent below 1970 levels in complying with the original Clean Air Act of 1970. That early response made Illinois an environmental leader through CCT research and development.

With that same spirit, we'll meet the emission reduction requirements of the 1990 Clean Air Act as well, leading the movement to coal as an energy and environmental choice of the 21st century. ✦

Technology U Close: Flue Gas Desulfurization

(Each quarter, the "Illinois Coal Update" focuses on a differe clean coal technology (CCT). Sin 1978, funding for 17 CCT projects in Illinois has been provided by th Illinois Coal Development Board, well as by private parties and the U.S. Department of Energy. Thes programs are administered by the Illinois Department of Energy and Natural Resources).

Proving that clean coal technolo gies can be both effective and cost efficient, the Abbott power plant at t University of Illinois in Champaign was one of six plants nationwide to receive the 1990 Power Plant Award from POWER Magazine.

According to POWER, the Abbott plant represents "leadership in the ap plication of fresh ideas and new tech nology and equipment to minimize environmental impact and maximize efficiency." The award was bestowe on the Abbott plant for its flue gas

Below, Don Fortik, plant manager at the Abbott power plant, observes the inner workings of the plant's boiler at the University of Illinois in Champaign. The Abbott plant (pictured right) was one of six plants nationwide to receive the 1990 Power Plant Award from POWER Magazine. Abbott was honored for its flue gas desulfurization device known as the Chiyoda Thoroughbred (CT-121) scrubber.

desulfurization device, known as the Chiyoda Thoroughbred (CT-121) scrubber.

While conventional scrubbers operate to remove sulfur compounds formed during coal combustion, the CT-121 second-generation scrubber removes sulfur dioxide from the gas generated during coal combustion. The process combines the gas with a substance that reacts chemically with sulfur dioxide to absorb it. The most commonly used absorbing materials, or sorbents, are lime or limestone dissolved in liquid.

Ultimately, the CT-121 flue gas desulfurization (FGD) unit creates a saleable gypsum by product with 50 percent less volume than the wastes produced by conventional scrubbers of equal size.

The CT-121 has a sulfur dioxide removal efficiency of more than 90 percent. During a year-long test program conducted by the Illinois Department of Energy and Natural Resources, the Electric Power Research Institute and the Radian Corporation, the CT-121 scrubber achieved 99 percent reliability, according to POWER.

Abbott power plant's FGD unit scrubs the combustion gas from 100,000 tons of high-sulfur Illinois coal and uses 9,000 tons of Illinois limestone each year. It has created 60 to 70 permanent mining jobs in the state and has annually saved the university about $3 million since the project started in April 1988, by using coal instead of natural gas for heating, cooling and electric power generation.

The FGD process involves flue gas from coal boilers passing through an electrostatic precipitator, an electrical device that removes ash and particulate matter. The gas is subsequently cooled by water and pumped into the scrubber unit, which contains a slurry, or mixture, of water, limestone and gypsum seed crystals.

Flue gases are then forced through a jet bubbling reactor, mixing the gas and slurry. Nearly all of the sulfur dioxide present in the gas diffuses into the slurry and reacts with calcium carbonate in the limestone to form calcium sulfate, or gypsum. Clean gas is then emitted from the plant's smokestack, leaving behind a saleable gypsum by product, which is pumped out of the reactor and stored in a holding tank.

Provided that the CT-121 unit can maintain the reliability achieved in the aforementioned test program, state officials estimate that demand for Illinois high-sulfur coal could increase at utilities and industries that would utilize the FGD process. That increased demand would in turn create additional jobs for Illinois coal miners and stimulate more economic activity for tangential businesses in mining towns.

"We spend over $500 million on the most definitive study of acid precipitation that's ever been done in the history of the world any place, and then we don't want to listen to what they say."

"60 Minutes" Reports on the NAPAP Study

Recently CBS' "60 Minutes" aired an investigative report with interviewer Steve Kroft about acid rain and the findings of the National Acid Precipitation Assessment Program—NAPAP. Below are highlights from the program, including comments from Dr. James Mahoney, director of the NAPAP report.

KROFT: Acid rain and ecological catastrophe: two phrases that in many people's minds have become almost synonymous. But the most expensive and exhaustive scientific study ever conducted on an environmental problem, which took 10 years, hundreds of millions of dollars and thousands of scientists to conduct, is about to publish its final report, which takes the conventional wisdom about acid rain and shoots it full of holes.

What about the effect of acid rain on lakes? Well, for the past 10 years it's been widely reported that lakes in the Northeast are dying by the thousands, and a report by the National Academy of Sciences in 1981 predicted that the number of acid-dead lakes would nearly double by the year 1990. Has that happened?

MAHONEY: No, definitely not.

KROFT: What's the increase been?

MAHONEY: Our best estimate is that the number of acid lakes is probably just about the same now as it was a decade ago.

KROFT: The study did confirm some concerns about acid rain. The sulfur emissions that cause it affect visibility. Acid rain itself does damage buildings and statues. But the problem is getting better, not worse. Sulfur emissions are down more than 25 percent since the Clean Air Act of 1970 went into effect, and those emissions will continue to drop as more and more old coal-burning factories are phased out and replaced...

The 10-year NAPAP study has not, however, been received as good news by most environmental groups. David Hawkins, a lobbyist for the National Resources Defense Council, says there's not much new in the NAPAP study...

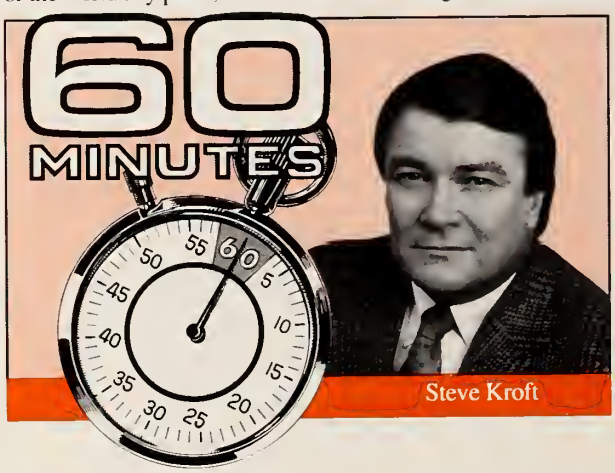
HAWKINS: The environmental community has spent almost no effort attempting to even monitor the progress of this program... We have been working on trying to get legislation in Washington to clean up the problem, actually attack the pollution problem.

KROFT: So you've been working the political angles of it?

HAWKINS: I've been working the legislative angle of it, yes, trying to get a new law to control the pollution.

KROFT: Hawkins says that even if acid rain isn't a crisis, he considers it serious enough to require action. And the legislation he's talking about is the tough acid rain provision of the new Clean Air Act, which his group, other top environmental lobbyists, the President and the Congress pushed through at the end of this last session. It will cost U.S. industries $4 billion to $7 billion a year to cut emissions that cause acid rain in half. What about the NAPAP study? It wasn't even a factor.

SENATOR JOHN GLENN (D-OH): We spend over $500 million on the most definitive study of acid precipitation that's ever been done in the history of the world any place, and then we don't



KROFT: Senator John Glenn is concerned that the new legislation to cut down smokestack emissions will have a devastating effect on his home state of Ohio, not to mention Pennsylvania, West Virginia, Kentucky and parts of Indiana where high-sulfur coal... is not only the main source of energy but a major source of employment.

About the only person who has written about the NAPAP study is syndicated columnist Warren Brooks, who's made it a crusade. Brooks has read the reports, studied the science and his conclusions have become the gospel for a growing number of people convinced that America is suffering from environmental hypochondria and that this acid rain legislation is just the most recent example.

BROOKS: If it's a crisis, we should act. We should, you know, damn the torpedoes, full speed ahead. What this study shows clearly is it's not a crisis. We should not damn the torpedoes. We should do it sensibly so we don't throw people out of work unnecessarily.

KROFT: Why has nobody listened to it?

BROOKS: Well, the point is that once their minds are made up--that is, "We're going to do something on acid rain. We're going to do something" -- the politics is, "We're going to do something."

KROFT: So you're saying this has a lot more to do with politics than it does with science.

BROOKS: Absolutely.

KROFT: So what are we going to get for those billions spent to control acid rain, not to mention the lost jobs?

BROOKS: Now, that's at $5 billion a year for whatever, 50 years. That comes out to about $4 billion a lake.✦

Reprinted by permission of CBS.

"The future for Illinois coal can be bright if we can keep our present infrastructure in place while continually pushing hard for clean coal technology."

Illinois Coal Association: A Look Ahead

Joe Spivey has worked in the coal industry for 16 years, including 14 years as president of the Illinois Coal Association, the Springfield-based professional trade organization that works to promote Illinois coal to current and potential customers. The Illinois Coal Update recently interviewed Spivey on a number of issues important to the future of the Illinois coal industry.

Q. *How has the Clean Air Act affected the Illinois coal industry?*

A. First, we should look at the historical setting of the Clean Air Act since 1970. At that time the Illinois Coal Association predicted that there would be an impact on Illinois coal, a high-sulfur bituminous coal, which would involve coal or other fuel switching on a large scale.

Federal and state regulatory officials and others made a very strong case in pointing out that there would be no "real" loss in coal production because our major customers, the utility industry, would put scrubbers in their facilities to allow the use of high-sulfur coal. In fact, they predicted that the future for Illinois coal was bright and that growth would occur from an average level of 60 million tons annually to approximately 85 million tons, and all within the confines of the 1970 Clean Air Act.

Of course, the regulators were wrong and we lost roughly 16 million tons of annual coal sales in Illinois alone. Fortunately for those in our industry with a very energetic marketing program, we were able to find markets to help offset that loss, primarily in the Southern and Southeastern states.

Q. *What impact will the new Clean Air Act mandates have on Illinois' coal industry?*

A. The future for Illinois coal can be bright if we can keep our present infrastructure in place while continually pushing hard for clean coal technology. If, on the other hand, the utility and industrial sectors switch coals or fuels in order to meet the revised Clean Air Act mandates, especially in Phase I, the Illinois coal industry could be in jeopardy.

It is difficult to predict at this time exactly how much switching, blending and scrubbing will occur, especially in the first phase. But based on current utility forecasting, with some uncertainties as to what many utilities will or will not do, by 1995 we could lose 10 percent of our current market in Phase I. Possibly within the next 10 years we could lose as much as 30 percent by the end of Phase II.

Q. *What is the initial response from Illinois coal customers about their plans to meet the Clean Air Act's deadlines?*

A. Based on conversations with people in the utility industry, we feel somewhat comfortable about the continued use of Illinois coal within Illinois. The problem, and the real concern, is that two-thirds of the 60 million tons produced each year are exported to other states. We are very concerned about this market area, particularly those utility plants that are not currently scrubbing or using some other control technology.

We are fortunate to have a high-quality, high-Btu coal and to have an excellent transportation network at very reasonable shipping rates. This gives us some advantage, and a utility may find it much more prudent and less costly to scrub rather than switch types of coal, or change to some other fuel source.

Q. *What is your reaction to the results of the NAPAP study, and the apathetic reaction to it by many media?*

A. It is extremely frustrating that this study and its findings have been almost completely ignored by the media and certainly ignored by the Congress of the United States. I might add that Congress had requested and paid for this study.

Joe Spivey, president of the Illinois Coal Association.

Q. *How do you see high-sulfur coal fitting into the nation's energy picture in the years ahead?*

A. Illinois coal at some point will be used, and used in large quantities. The Illinois coal basin has 187 billion tons of known coal reserves, 35 to 40 billion tons of which are recoverable by current mining methods. Clean coal technology as it exists now and in the future will permit more use of our coal. As a nation we have no choice but to rely on our greatest fossil fuel resource—coal—for many years to come.

Q. *Are there any special "task force" strategies in progress to offset the Clean Air Act?*

A. Over the past 10 years we in the state of Illinois have developed coal promotions, research programs and tax incentives for coal use. Also, we developed a policy that all state institutions are to use Illinois coal where possible. During this session we will present to Illinois legislators additional programs that will further encourage the use of Illinois coal and CCTs.✦

Office of Coal Development and Marketing
Illinois Department of Energy and Natural Resources
325 W. Adams, Room 300
Springfield, IL 62704-1892

Illinois Coal Update

Illinois Department of Energy and Natural Resources

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

- **NAPAP Report Puts Acid Rain in Perspective**
  Insight into the most comprehensive scientific study ever undertaken by the federal government, the National Acid Precipitation Assessment Program (NAPAP).

- **Technology Up Close**
  Insight into the award winning Abbott power plant that received the 1990 Power Plant Award from POWER Magazine.

- **"60 Minutes" Interview with Key People in the Coal Industry Regarding the NAPAP Study.**
  Reporter Steve Kroft interviews Dr. James Mahoney, director of the NAPAP report, and others regarding their response to the overall reaction from the government to the NAPAP Study results.

Printed by Authority of the State of Illinois.
Printed on recycled paper.

ILENR/CD-90/02(91-2)

Illinois Coal Update

ENR
Illinois Department of
Energy and Natural Resources

Volume 4, Number 4 1991

Illinois Department of Energy and Natural Resources Office of Coal Development and Marketing John S. Moore, Director, Jim Edgar, Governor

Edgar's Coal Delegation Makes Case for Illinois

To help preserve the livelihood of numerous southern Illinois communities that rely on the Illinois coal industry, Gov. Jim Edgar formed the Illinois Delegation for Clean Coal. The Delegation's goal is to educate utility executives about the economic and environmental advantages of Illinois' compliance options. The five-member team began discussions in July with utility companies in Missouri and Indiana and has met with coal-buying decision-makers in Alabama and Florida.

Out-of-state utility companies presently account for two-thirds of Illinois' coal production. By the year 1995 many of these utilities will be faced with the decision to "switch or scrub" to comply with Phase I Amendments of the 1990 Clean Air Act. Utilities presently are considering their options, which include switching to lower sulfur western coal or choosing to install clean coal technologies (CCTs) to meet the Act's deadlines.

The Delegation's objective is to provide facts and viable options that support the continued use of Illinois coal as the preferred compliance option. It also introduces utility companies to technology vendors and Illinois coal companies that will secure long-term contracts at low rates.

Delegation members are:

Allen Grosboll, *executive assistant to Governor Jim Edgar*

Grosboll, the Delegation's chairman, serves as executive assistant to Illinois Gov. Jim Edgar, overseeing energy and environmental matters. He has been involved in Illinois state government since 1973, working in both the executive and legislative branches. Grosboll's assignment underscores the governor's commitment to preserving Illinois as a national leader in coal production and the development and demonstration of CCTs.

John S. "Jack" Moore, *director of the Illinois Department of Energy and Natural Resources*

As a key player in the development of the Delegation, Moore coordinates the collection and dissemination of technical information to provide a basis for out-of-state utility compliance decisions. Technical information includes economic impact analyses, potential emission reductions and benefits of CCTs. Moore is chairman of the Illinois Coal Development Board (ICDB).

Ronald Morse, *director of the Illinois Department of Mines and Minerals*

Morse brings an industrial perspective as well as a regulatory background to the Delegation. He provides accurate and concise statistics on Illinois coal production, employment and Illinois Basin coal specifications to out-of-state utilities. Morse is also an ICDB member.

Gerald Hawkins, *director of governmental relations, Illinois United Mine Workers of America*

Hawkins has a deeply rooted understanding of the concerns and plight of coal miners in Illinois. As director of governmental relations for the UMWA, his political experience aids the delegation in understanding coal's economic impact to the state and to the union members he represents by providing employment and mining data for Illinois.

Taylor Pensoneau, *vice president, Illinois Coal Association*

Pensoneau has worked with state political coal marketing issues during his 13 years of service with the Illinois Coal Association. He acts as a liaison between out-of-state utilities and Illinois coal companies, focusing on the marketing aspects of Illinois coal as an economical and plentiful source of safe power production. ✦

Coal Board Oversees State Research Work

With the revisions made to the federal Clean Air Act in 1990, clean coal technologies (CCTs) have become more important than ever to Illinois' coal industry. Those CCTs may well mark the difference between growth, maintenance or survival for the state's high-sulfur coal industry, which employs 12,000 coal miners and is responsible for thousands of related jobs.

Overseeing state-sponsored research, development and demonstration programs of CCTs is the Illinois Coal Development Board (ICDB), in conjunction with the Illinois Department of Energy and Natural Resources. ICDB was formed in 1982 to support and coordinate Illinois coal research development, seek and appropriate funds for CCT demonstration projects, and pro-

(continued on page 2)

Moore Morse

"Significantly, many global climate change theorists point out that improving energy efficiency is cheaper, faster and safer than any alternatives."

Coal Board

(continued from page 1)

mote new research and ongoing developments for state coal.

Efforts by the ICDB and Illinois ENR have helped make Illinois the nation's leader in the testing, development and demonstration of CCTs since the 1970s. In addition, the Board's judicious use of funds to date has resulted in more than $1.4 billion in matching funds from the U.S. Department of Energy and private sources.

Since its inception ICDB has approved more than $113 million in funding for 17 CCT projects. The list includes:

- A mild coal gasification process designed to produce a solid fuel, liquid byproducts and a gas to fire the demonstration plant itself. Testing will occur at the Illinois Coal Development Park;
- A second-generation scrubber, a flue gas desulfurization device known as the Chiyoda Thoroughbred (CT-121), that has a sulfur dioxide removal efficiency of more than 90 percent. The CT-121 is operated at the University of Illinois' Abbott power plant;
- A coal-water mixture known as a slurry, a coal combustion system for generating heat. The 39-month project underway at the Illinois Coal Development Park studies the most efficient coal-water mixtures and the specifications for the combustor;
- A duct injection flue gas desulfurization technology for which project results to date have achieved between 40 percent and 50 percent removal of sulfur dioxide. The first phase of testing has been completed at the Central Illinois Public Service Company's Meredosia plant in central Illinois;
- A gas reburning-sorbent injection (GR-SI) technology being tested at the Illinois Power Company's Hennepin Station in northern Illinois. The goal is to demonstrate the capability to remove 60 percent of nitrogen oxide and 50 percent of sulfur dioxide from coal-burning emissions;
- A fluidized bed combustion system that cogenerates steam and electricity while capturing more than 90 percent of sulfur dioxide emissions. Archer Daniels Midland Company of Decatur uses the technology at its five locations.

The ICDB's 11 voting members help fund newer and better CCTs, each of which can be crucial to the state's coal industry.

Sketches of the two members who joined the Board in 1991:

John S. Moore—Moore, who serves as ICDB chairman, was appointed director of Illinois ENR by Gov. Jim Edgar in February 1991. Previously, Moore was director of the Division of Petroleum and Chemical Safety in the office of the State Fire Marshal, and also served 11 years with the Illinois Environmental Protection Agency. Moore was the first full-time air pollution specialist with the Illinois Department of Public Health, and was president of his own consulting firm that provided environmental and risk consultation. He earned a B.S. degree in geology from the University of Illinois.

Ron Morse—Morse was appointed director of IDMM by Gov. Edgar in March 1991. He joined the Department after serving more than 20 years with the Sahara Coal Company as safety director. Morse also was a certified instructor of safety-related programs for both IDMM and the U.S. Department of Labor. He earned a B.S. degree in occupational education from Southern Illinois University-Carbondale. ✦

Present Board Members

Hon. Ralph Dunn, state senator, legislative district #58
Linda A.F. Dutcher, geologist
Carolyn J. Ehlert, manager, Illinois legislative affairs, Deere and Co.
Jan M. Grayson, director, Illinois Department of Commerce and Community Affairs (CCA)
Edgar Hale, United Mine Workers of America
John S. "Jack" Moore, director, Illinois Department of Energy and Natural Resources (ENR)
Ron Morse, director, Illinois Department of Mines and Minerals (IDMM)
Richard E. Newtson, vice president, A.G. Edwards and Sons, Inc.
Hon. David Phelps, state representative, legislative district #118
David L. Stritzel, corporate director of safety, Zeigler Coal Company
Porter Womeldorff, vice president, Illinois Power Company

Coal and Global Climate Change

By Kim Underwood, Director, Office of Coal Development and Marketing Illinois Department of Energy and Natural Resources

There is no relief from assault on the coal industry, as a look at headlines in any newspaper or magazine will attest.


Kim Underwood

While Illinois and the rest of America's high-sulfur coal states respond to federal Clean Air Act mandates about acid rain control, increasing attention is being paid to the phenomenon known as global climate change, or the greenhouse effect. And guess where the finger of blame is being strategically pointed? The coal industry, of course.

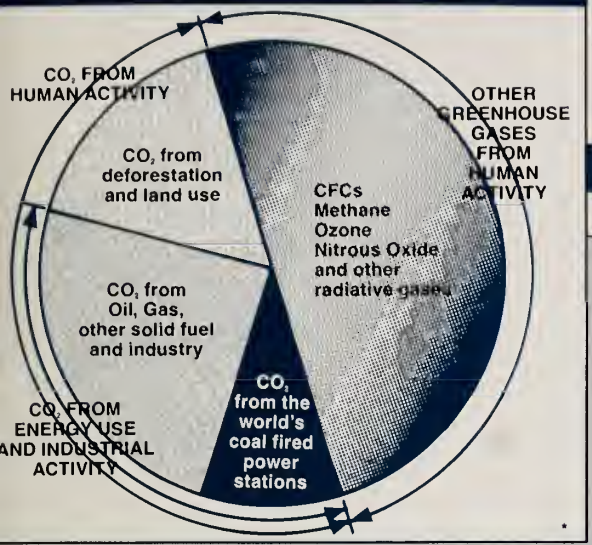
Human activity since the dawn of the Industrial Age has greatly increased the quantity of greenhouse gases emitted into the atmosphere. Some scientists have speculated that global temperatures may be rising as a consequence of such an increase.

Atmospheric water vapor, carbon dioxide, methane and other infrared-absorbing gases are known as greenhouse gases because they trap the Earth's radiant heat. Trace levels of these gases make life on Earth possible.

James Hansen, director of NASA's Goddard Institute for Space Studies, and Tom Wigley, professor and head of the Climate Research Unit at East Anglia University in England, have each led research groups that conclude that the world temperature has risen by nearly 1 degree Fahrenheit in the past century, with nearly half that rise since 1965.

But is it global climate change? A 1990 documentary titled "The Green-

The Relative Contribution of Greenhouse Gas Emissions



* *Coal and the Greenhouse Effect' WORLD COAL INSTITUTE*

use Conspiracy" observes that the bal climate change theory is based on four "pillars," each of which is spect. The pillars of record (factual idence), cause (primarily carbon oxide), models (based on climate pre-tions) and physics all have been allenged by reputable scientists.

While there is uncertainty among entists as to the amount of global cli-ate change, one point is certain: An ernational negotiating committee onsored by the United Nations has gun deliberations on an international mate convention, targeting an agree-ent for June 1992. That agreement will ely include numerical goals for reduc-greenhouse gas emissions.

As with acid rain, though, the Illi-is coal industry is part of the solution, t the problem. The U.S. Department Energy states that boosting energy iciency is the best means available to luce carbon dioxide emissions from al-burning plants. And the clean coal hnologies being researched, tested d demonstrated in Illinois can lead the ion, and the world, to a more efficient e of coal.

While water vapor, methane, chlo-luorocarbons, ozone and nitrous oxide ntribute to the greenhouse effect, car-n dioxide is responsible for 50 percent all man-made greenhouse gases. rning of fossil fuels contributes 70 rcent of that carbon dioxide, or 35 rcent of man-made greenhouse gases, cording to Irving Mintzer of the Cen-for Global Change. The burning of al specifically accounts for approxi-tely one-fourth of fossil fuel burning.

Thus, coal-fired power plants emit proximately 8 percent of all carbon oxide into the atmosphere, says the orld Coal Institute.

Significantly, many global climate change theorists point out that improving energy efficiency is cheaper, faster and safer than any alternatives. Alan Miller and Mintzer of the Institute for Global Change wrote in the Fall '90 issue of SCIENCE AND TECHNOLOGY that "an aggressive international response to greenhouse-gas emissions can be reconciled with vigorous and equitable economic growth."

So where do all these facts, theories and opinions put Illinois' coal industry? Squarely behind the clean coal technologies that Illinois has investigated as environmentally and economically sound solutions to energy needs.

The ability to use coal up to 20 percent more efficiently than at present will further diminish the amount of carbon dioxide produced by the generation of electricity. That's the opinion of the World Coal Institute, but also of Dr. K.M. Sullivan, former president of the International Union of Air Pollution Prevention Associations, who authored a study on carbon dioxide emissions from coal-fired power plants.

The importance of such projects as the mild coal gasification and Tecogen coal/water "slurry" projects at the Illinois Coal Development Park, the gas reburning-sorbent injection project at Illinois Power Company's Hennepin Station show great promise to provide cleaner and more efficient use of Illinois high-sulfur coal in environmentally progressive ways.

In addition, the Illinois Department of Energy and Natural Resources' State Water Survey has launched a major Global Climate Change Program. The Survey is expanding research into climate processes and how climate impacts Illinois' environment and socioeconomic structure.

Reality or not, global climate change is a political fact of life. Ongoing work in Illinois to develop clean coal technologies will make living with that fact easier and more beneficial for the state's coal industry and for the industry as a whole. ✦

"Work is geared toward making coal a viable, compliance-achieving fuel choice that helps maintain jobs."

Researching Coal at Illinois Coal Development Park

It is doubtful that closer attention has ever been paid to the environment since the inception of the Industrial Age two centuries ago. And while the Clean Air Act, the U.S. Environmental Protection Agency and Earth Day have grabbed their share of headlines in the past two decades, work at the Illinois Coal Development Park (ICDP) has been prevalent throughout.

Of course, the park's name itself is a recent part of its history. Originally, back in the mid-'70s, it was known as the U.S. Bureau of Mines Carbondale Mining Technology Center. In 1980, the location was taken over by the U.S. Department of Energy. At that time, the Coal Technology Laboratory began operating under contract for Southern Illinois University's (SIU) Coal Research Center.

Scientists and engineers at the Coal Technology Laboratory worked on numerous clean coal technology development projects, ranging from coal gasification to advanced scrubbers. When the federal government turned the laboratory over to Illinois in 1989, it had developed a reputation for excellence in research of the usage of high-sulfur coal in an environmentally acceptable manner.

A scientist at the Illinois Coal Development Park examines the effectiveness of suspending crushed coal particles in liquid to remove sulfur.

The renamed Illinois Coal Development Park underwent a year of renovations while research efforts continued, and was officially dedicated during Coal Awareness Week festivities in Illinois in October 1990.

Located near Carterville in Williamson County in southern Illinois, the park contains 25,000 square feet of office space in two buildings. The full-time employees investigate ways to use high-sulfur coal cleanly and efficiently.

The park houses the Illinois Department of Energy and Natural Resource's (ENR) Center for Research on Sulfur in Coal (CRSC), the largest state-supported research program in the nation. CRSC shares space in the park's administration building with SIU's Coal Maceral Separation and Coal Characterization Laboratory.

Other state offices housed at the park include the Illinois Department of Mines and Minerals Land Reclamation Office and an Illinois Geological Survey field office. Future plans call for the park to house the Illinois Coal Information Clearinghouse, now in the planning stage of development.

As CRSC director Richard Shockley points out, work is geared toward making coal a viable, compliance-achieving fuel choice that helps maintain jobs.

Two new projects have further increased the park's commitment to clean coal technology research, says Shockley. A proposal for an $18 million, mild gasification circulating fluidized bed combustion project has been approved by the Illinois Coal Development Board, and work is ready to begin on a $2.6 million research project in cooperation with Tecogen, Inc. The latter will demonstrate the use of a coal/water mixture known as a slurry to be used for generating heat.

The Illinois coal industry adds $1.5 billion annually to the state's economy, and is looking at hard times ahead with the passage in late 1990 of strict revisions to the Clean Air Act. Thus, research being conducted at ICDP is of critical importance to Illinois and to many of its residents.

Randall Lubbert, a dragline instructor at the Illinois Coal Development Park, demonstrates how he trains surface mine machine operators to extract coal more efficiently.

Scientists in the maceral separation laboratory microscopically analyze minerals and materials within coal to better understand high-sulfur coal. Researchers devote their efforts to identifying the physical and chemical building blocks of coal. Such identification may eventually help in the pre-combustion removal of sulfur from coal, a complicated process because there are variations of sulfur found in bituminous coal.

One researcher at the park, Steve Palmer, has discovered that a simple, chemical, peroxy acetic acid has removed all pyritic sulfur and 25 percent of organic sulfur from coal during testing. Another team of researchers, John Crelling and Ken Tempelmeyer, is experimenting with cooling coal, enabling the bonds between various components in coal to be weakened and then broken.

Adjacent to the administration building is the ICDP's dragline simulator and surface mining training area. Here dragline instructors train surface mine machine operators to extract coal more efficiently.

"The underlying theme of the whole park is to make coal more efficient," says Kim Underwood, director of ENR's Office of Coal Development and Marketing. "While much of the work at the park is focused on the research and development of clean coal technologies, we're also interested in making the extraction of coal as economical as possible." ✦

"The sharing of information has been beneficial to the utilities and to state officials."

Illinois Clean Coal Delegation Sells for State

In late May Governor Jim Edgar announced the formation of the Illinois Delegation for Clean Coal. The Delegation meets with utility companies which currently purchase Illinois high-sulfur coal, and presents arguments for the utilities' continued use of Illinois coal to comply with the Clean Air Act. Allen Grosboll, executive assistant to Edgar, chairs the Delegation and was recently interviewed by the Illinois Coal Update.

Q. *What is the role served by each member of the Delegation?*

A. Each of the people of the Delegation brings a different perspective. I'm here representing Governor Edgar, making a clear statement that the Delegation was established by the governor and is of the utmost importance.

Jack Moore is head of the Illinois Department of Energy and Natural Resources, and has been involved for many years in coal development programs. Ron Morse's Department of Mines and Minerals has the job of protecting the health and safety of the state's miners.

Gerald Hawkins of the United Mine Workers represents the interests of 12,000 miners in this state, half of whose jobs are in jeopardy. Taylor Pensoneau, vice president of the Illinois Coal Association, represents various companies who do business in Illinois mining coal, and who have hundreds of millions of dollars invested in the state.

Q. *What is the foremost purpose of the Delegation?*

A. Governor Edgar has set as our primary goal to meet with out-of-state utilities which have historically used Illinois coal and to urge them to continue burning Illinois coal. We believe studies show that using clean coal technologies in association with Illinois coal is in the long run a wise and economically beneficial policy. It is also better for the environment than switching to western coal.

By visiting these utilities we have opened a dialogue. As utilities are making these decisions regarding fuel-burning for the future, the state of Illinois has become a "player." Illinois is unique in this regard.

Q. *What has been the reaction of utilities visited by the Delegation?*

A. It has been very positive. Generally, they've been open to us and we've had good, informative meetings. The sharing of information has been beneficial to the utilities and to state officials.

Q. *What is the outlook for Illinois coal in the wake of the 1990 revisions to the Clean Air Act?*

A. I think the initial outlook was very bad. We believed that more than half of our coal sales of 60 million tons per year were placed in serious jeopardy as a result of the Clean Air Act. Somewhere between 5,000 and 6,000 coal jobs were threatened. And if we include spinoff jobs created by the coal industry directly and indirectly, a total of 21,000 to 22,000 jobs were at risk.

Today we feel cautiously optimistic that some of the negative outlook may be somewhat diminished. We are seeing that as more information becomes available to utilities, and those utilities give additional thought to alternatives for meeting Clean Air Act requirements, they are considering the use of clean coal technologies in conjunction with Illinois coal.

Q. *What should Illinois do in the next decade as Phase I and Phase II of the 1990 Clean Air Act revisions are implemented?*

A. Illinois needs to continue the dialogue that Governor Edgar has initiated through the Coal Delegation. The Delegation's responsibilities will turn to advancing clean coal technologies and to expanding markets for the state's coal industry.

Q. *On what information does the Delegation base its argument for continued use of Illinois coal by targeted utilities?*

A. We have researched all of the contracts that the state's coal industry has today. We know where every ton of Illinois coal goes, and for how long the contracts extend. We know the cost of purchasing clean coal technologies and spreading that cost over the life of a facility, and we also know the expense involved in switching fuels and paying higher transportation costs. Plus we've gleaned information from the utilities' reports and meetings.

Allen Grosboll, executive assistant to Governor Jim Edgar

Q. *What is the relative importance of the threefold themes — Clean Air, Low Rates, Good Jobs for the Midwest — of the Delegation?*

A. On "Clean Air," we believe that by using clean coal technologies and burning Illinois coal the amount of pollution released into the atmosphere is substantially lower than emissions from burning other fuels and not scrubbing.

We think "Low Rates" are there because clean coal technologies and associated costs are well understood. Long-term contracts for Illinois coal can be obtained with very low transportation costs. In the long run Illinois coal provides a more stable economic base than coal a thousand miles away that will have uncertain transportation costs during the coming decades.

As for "Good Jobs for the Midwest," the Clean Air Act amendments of 1990 put severe pressure on the Midwest, particularly Illinois. No other area in the country is in such jeopardy. By using Illinois coal and clean coal technologies we can stabilize the job situation in this region. We think that's a worthy goal. ✦

Office of Coal Development and Marketing
Illinois Department of Energy and Natural Resources
325 W. Adams, Room 300
Springfield, IL 62704-1892

Illinois Coal Update

Illinois Department of Energy and Natural Resources

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

- **Gov. Edgar's Clean Coal Delegation Takes to the Road**
  Hitting the "campaign trail" to discuss new contracts with out-of-state users of Illinois coal.

- **The Illinois Coal Development Board**
  A look at the organization that oversees state-sponsored research, development and demonstration of clean coal technologies.

- **Global Climate Change**
  The Illinois coal industry is part of the solution, not the problem.

Printed by Authority of the State of Illinois.
Printed on recycled paper.

Illinois Coal Update

ILENR/CD-90/02(92-1)

ENR Illinois Department of Energy and Natural Resources

Volume 3, Number 1 1992

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

CCT Funding Tops $1 Billion in Illinois

Funding for clean coal technologies (CCT) has surpassed the $1 billion mark in Illinois, according to statistics from the Illinois Department of Energy and Natural Resources (ENR). Through a combination of funds from the federal government, the state and private sources, Illinois has maintained its leadership role in CCT research and demonstration.

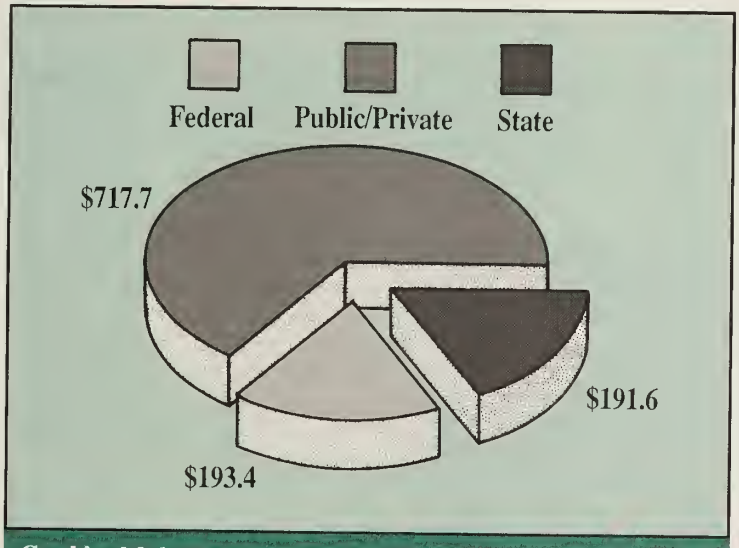
For nearly 15 years, Illinois has made a significant economic contribution to the research and demonstration of clean coal technologies. The state is aggressively working to lead the Midwest and the United States into 1995, when targeted power plants are mandated by 1990 revisions to the Clean Air Act to meet Phase I clean air requirements. The development of CCTs has made it possible for utilities to continue using Illinois coal, as opposed to switching to western coal at the expense of coal mining jobs.

Since the 1970s, Illinois has been involved in 20 CCT projects, offering advanced and efficient options to the energy marketplace. A few of the more prominent CCT projects commercially operating in Illinois include:

• The Pyropower circulating fluidized bed combustion boiler in Henry has been operating since 1984 at competitive industry costs, a factor for utility companies to weigh when examining the costs of CCT implementation.

• The Abbott power plant located on the University of Illinois campus in Champaign utilizes a flue gas desulfurization process known as the Chiyoda Thoroughbred (CT-121) scrubber. The CT-121 system scrubs more than 100,000 tons of Illinois coal annually. The project has saved the university more than $3 million in heating and cooling costs since 1988.

There are also several CCTs in the introductory phase at utility plants in Illinois:



Combined federal, state and private funding sources have maintained Illinois' leadership role in CCT research and development.

• The Illinois Power plant in Hennepin, and the City Water, Light & Power (CWLP) station in Springfield, have introduced gas reburning-sorbent injection technology. This process involves reburning gas and injecting a calcium-based sorbent compound into the high-temperature region of the furnace. Originally, the goals of this process were to remove 60 percent of nitrogen oxide and 50 percent of sulfur dioxide from plants burning high-sulfur coal. However, results from the Hennepin station show that the pollution control system has surpassed expectations with nitrogen oxide emissions cut by up to 77 percent and sulfur dioxide emissions reduced by up to 62 percent.

According to the Department of Energy (DOE), gas reburning-sorbent injection can be used in several Phase II compliance utility boilers throughout the country. Because it is one of the more economical systems to install, and can be adapted to existing equipment in older facilities, researchers have concluded that gas reburning-sorbent injection may be even more economically and environmentally sound than originally anticipated.

• The Combustion Engineering Integrated Gasification Combined Cycle (IGCC) Repowering Project is being developed at the CWLP's Lakeside Station in Springfield. The system removes sulfur from Illinois coal by means of a pressurized, low-Btu gasifier. The commercial results, according to the DOE, could translate into a 99 percent decrease in sulfur dioxide emissions and elimination of 95 percent of nitrogen oxide, while also lowering carbon dioxide emissions by nearly 30 percent over the current technology.

The commercial application of IGCC is a highly regarded alternative for new electricity generating plants. Advantages of this system are low environmental emissions and high net plant efficiency. This will allow the Springfield utility to continue producing electricity strictly from Illinois coal well past the year 2000. ✦

"We will fight for every job and find new ways to effectively use Illinois coal."

CCTs Are Vital to Future of State Coal Industry

Commitment to research and development of clean coal technologies (CCTs) is vital to the future of the Illinois coal industry as it struggles with the repercussions of the 1990 Clean Air Act (CAA) revisions.

The tonnage of coal mined in Illinois in 1991 dropped slightly from a 1990 total of 61.7 million tons to approximately 60 million tons. Also, employment in the Illinois coal mining industry suffered a decline of approximately 500 jobs in 1991.

However, two significant developments took place in Illinois during the year to safeguard the coal industry, which annually contributes $1.5 billion to the state's economy.

In May, Governor Jim Edgar formed the Illinois Delegation for Clean Coal. This five-member team, comprised of experts in state government and in the Illinois coal industry, promotes the use of CCTs and Illinois coal with utility executives as they develop strategies for compliance with the CAA revisions.

"The Delegation has been a positive undertaking, and we hope to continue our efforts in 1992 to save jobs and dollars for Illinois," says Taylor Pensoneau, vice president of the Illinois Coal Association and a member of the Delegation.

By signing Senate Bill 629 (P.A. 87-173), Governor Edgar enacted law designed to lessen the negative impacts of the 1990 Clean Air Act. Under the law, a utility is now required to consider economic factors when deciding to switch from Illinois coal to out-of-state low-sulfur coal. The legislation mandates the installation of four scrubbers at power plants in Illinois to reduce sulfur emissions while continuing to use Illinois coal.

What will 1992 bring to the Illinois coal industry? Most researchers and government officials predict that 1992 will be a year of leveling off, with the number of mining jobs and tonnage of coal mined in Illinois remaining constant. "We will fight for every job and find new ways to effectively use Illinois coal," states Richard Shockley, director of the Center for Research on Sulfur in Coal.

Plant manager Don Fortik presents the gypsum byproduct from the University of Illinois-Champaign's Abbott power plant.

The 110 power plants throughout the country targeted for Phase I compliance of the Clean Air Act must decide whether to scrub high-sulfur coal or switch to low-sulfur western coal in time to meet the 1995 deadline. Those plants and many others must find solutions to even more stringent emissions controls by 2000 when Phase II is implemented.

The Phase II deadline will impact western coal sales, since low-sulfur coal must also be scrubbed to meet those mandates. In the opinion of many Illinois coal officials, the storm surrounding Illinois coal may be short-term. However, markets lost prior to Phase II may not be regained.

"We suspect that utilities will begin to turn back to Illinois coal as we approach the late-'90s," says Pensoneau. "Western coal prices will rise, and nuclear energy has already reached a plateau. We believe that if we can hang on, Illinois coal will again be in demand." ✦

Technology Up Close: HSA Hydrated Lime

(Each quarter, the "Illinois Coal Update" focuses on a different clean coal technology (CCT). Since 1978, funding for 20 CCT projects in Illinois has been provided by the Illinois Coal Development Board, as well as by private parties and the U.S. Department of Energy.)

With the 1995 deadline for Phase I compliance with the Clean Air Act revisions looming ever closer, targeted utility plants throughout the Midwest, East and South are looking for ways to generate power within those new guidelines. At the same time, the state of Illinois has funded various CCTs that will enable plants which currently burn high-sulfur Illinois coal to continue burning that coal.

One CCT with vast potential is a new process producing high-

At the Illinois State Geological Survey, Jimmie Cooper, associate craftsman, David L. Moran, associate staff chemical engineer and Massoud Rostam-Abadi, senior chemical engineer, (left to right) test the high-surface-area hydrated lime process that removes up to 90 percent of sulfur dioxide emissions from combustion gases.

surface-area (HSA) hydrated lime in place of conventional calcium-based sorbents. This technology was developed at the Illinois State Geological Survey (ISGS) by senior chemical engineer Massoud Rostam-Abadi and associate staff chemical engineer David L. Moran. The product "is really good for older and smaller power plants which can benefit from a dry sorbent injection system," says Rostam-Abadi. A CCT or other sorbent injection technology must be installed in order to use the sorbent. This lime enhances sulfur dioxide (SO_2) removal.

"When our hydrated lime process began to look interesting," says Rostam-Abadi, "an independent consultant evaluated it. That consultant confirmed that the process is technologically feasible and likely to be economically attractive."

The HSA hydrated lime process has produced outstanding test results in various pilot-scale dry sorbent injection processes. The Survey's product has removed up to 90 percent of SO_2 from coal combustion gases. That represents up to a 70 percent increase in SO_2 capture over the best performing commercial hydrate tested, according to Moran.

Hydrated lime is used with a dry sorbent injection system. In order to remove sulfur dioxide from emissions resulting from the burning of high-sulfur Illinois coal, a dry sorbent can be injected into the boiler. Hydrated lime, injected either at the point of combustion or after, decomposes into lime which reacts with sulfur dioxide to form either calcium sulfate or calcium sulfite. The resulting solid products can then be easily collected, removed and possibly used as a construction material.

An important point for many targeted plants is that the projected cost of the HSA hydrated lime is only marginally higher than the cost of currently available commercial hydrated lime. For plants with a capacity of 150 megawatts or less, wet scrubbers that use a lime/water slurry can neither be installed nor used efficiently and cost-effectively.

Dry sorbent injection systems, though, are easier and less expensive to install, require less space and have lower projected capital costs than wet scrubbers. Presently, there are commercial hydrates available for dry sorbent injection that can cut SO_2 emissions from high-sulfur Illinois coal to compliance levels, but a large quantity of sorbent is needed to capture acceptable amounts of SO_2.

Not so with the HSA hydrated lime, according to Rostam-Abadi. "The HSA hydrates we've produced from Illinois' limestones," says Rostam-Abadi, "are very reactive because they have much greater surface area and porosity, and smaller particle diameter and crystallite size than commercial hydrated limes now used." Increasing the reactivity of the sorbent increases its capacity to remove sulfur dioxide; thus, less sorbent is needed to capture the required amount of SO_2. The efficiency of the HSA process equates to cost reduction.

ENR, through the Illinois Coal Development Board and Center for Research on Sulfur in Coal, has funded the project since 1986. More recently, the ISGS has received an award from the Illinois Department of Commerce and Community Affairs and has designed, constructed and is now testing a process optimization unit, which is housed in a modified Minerals Engineering laboratory at the ISGS. ✦

"CCTs developed within the state actually are the wave of the future for meeting the even more exacting Phase II compliance mandates."

Coal: The Shape of Things to Come

By Kim Underwood, Director, Office of Coal Development and Marketing Illinois Department of Energy and Natural Resources

You've heard the old saying, "Put your money where your mouth is."

In Illinois, we've done just that. The State's commitment of $193 million to Illinois coal development has attracted another $718 million in public and private funds and $192 million in federal funds. As a result, more than $1 billion for research and development of Illinois clean coal technologies has done much to foster continued shipments from the mouth of every coal mine in the state.

It's been more than a year since President Bush signed into law revisions to the federal Clean Air Act, revisions which struck close to home for the Illinois coal industry. After all, Phase I compliance requirements under the legislation give power plants only until 1995 to put in place stringent sulfur dioxide emission reduction programs. Those reductions spell troubled times for Illinois mines currently feeding these plants with high-sulfur bituminous coal.

Indeed, a survey conducted by the Illinois Department of Energy and Natural Resources (ENR) found that out-of-state utilities plan to replace 13 million tons of Illinois coal which they currently purchase each year.

But, as we've said before, the Prairie State has been aggressively touting the long-term benefits of CCTs since the original Clean Air Act became law in the 1970s. We have important reasons for doing so: CCTs help to provide an environmentally clean energy source that is practical for meeting the nation's near-term energy needs; the best and the brightest CCTs are economically effective as well.

While the Clean Air Act may have dire short-term implications for Illinois, CCTs developed within the state actually are the wave of the future for meeting the even more exacting Phase II compliance mandates.

To comply with Phase II requirements, which take effect in the year 2000, utilities must go beyond switching to low-sulfur western coal, since it too may not meet future emission control standards. The solution? Clean coal technologies.

To get this message across, Governor Jim Edgar is working with the Illinois Legislature and a consortium of Illinois coal interests to preserve coal markets essential to the economy of numerous southern Illinois communities that rely on the coal industry.

In 1991, Governor Edgar signed into law Senate Bill 629 (P.A. 87-173). The new law requires Commonwealth Edison Co. to use Illinois coal through the installation of two scrubbers at its Kincaid facility. It also imposes a similar requirement on Illinois Power's Baldwin plant. In addition, the new law authorizes a $35 million state grant to Illinois Power to help fund part of its cost for scrubber installation.

Additionally, the bill requires the Illinois Commerce Commission to conduct hearings on pre-approved rate increases for utilities installing scrubbers, and to consider the impact on employment when Illinois coal use will decline 10 percent or more as a result of changes in the types of fuel used. The bill also broadens the authority of the Illinois Coal Development Board.

Governor Edgar also has vigorously promoted the benefits of CCTs through the Illinois Delegation for Clean Coal. The Delegation, named last May, is comprised of major state officials and coal industry representatives from both management and labor. Its goal is to work with utility executives as they develop their Clean Air Act compliance strategies and, in so doing, to promote the use of CCTs and Illinois coal.

With Ohio and Indiana also having enacted legislation to protect their state's coal interests, it seems that the next logical step would be to combine the joint efforts of Midwestern coal-producing states to form a Midwest coalition. Such a coalition would present a united front for the utilization of coal and CCTs, thus furthering the common interests of Midwestern coal producers, utilities and industries.

Forming such a coalition makes common sense. And, given the political climate which forced the economic winds of the Clean Air Act revisions to blow heavily on the Midwestern coal industry, it makes good business sense as well.

All of this activity underscores the vitality of coal mining in Illinois, not just historically but for the future. Left unattended, we must realize that the state's coal industry and mining communities will suffer, thus adversely affecting the Illinois economy. ✦

Kim Underwood

"Basic research leads to development which, in turn, leads to demonstration and eventual commercialization of coal utilization and combustion techniques."

Richard Shockley Discusses CRSC

Richard Shockley is director of the Center for Research on Sulfur in Coal (CRSC). A registered professional engineer by trade, Shockley's background includes a 35-year career with Inland Steel Coal Company, where he held mine and management positions. He is a past president of the Illinois Mining Institute, and as director of the Illinois Department of Mines and Minerals was a member of the Illinois Coal Development Board. Below is an interview with director Shockley.

Q. What is the CRSC?

A. The CRSC is a coal research organization founded in 1982, dedicated to basic research and development on coal. The Center administers statewide coal research programs. On a competitive basis, the CRSC evaluates coal research proposals, awards research grants and monitors the progress of projects funded by the Center. CRSC-funded projects are predominantly at colleges, universities and research organizations in Illinois and also out of state, where there is a potential to specifically enhance the marketing possibilities of Illinois coal. In fact, many of the coal research projects under way at the Illinois Coal Development Park in Carterville are funded by the CRSC. Presently, the CRSC is supporting 43 basic research projects with a budget of $3.75 million. Our eight-member staff is based at the Illinois Coal Development Park.

Q. What is basic coal research?

A. Basic coal research includes the study of the structural and thermal conversion characteristics of coal, as well as the development of techniques for removing the pyritic and organic forms of sulfur from Illinois high-sulfur coal. The Center also funds projects that improve coal grinding and preparation techniques. Coal has been used in the United States since before the Industrial Revolution, but we're learning more about this abundant resource all the time. Basic research is laying the groundwork for technological advances of the future.

Q. Why is the work of the CRSC important?

A. Simply stated, basic research enables science and industry to understand coal better and to find more efficient, lower-cost and environmentally sound ways to use it. Since the future viability of coal is so important to the state of Illinois, it makes good sense today for us to conduct research on this valuable resource. Basic research leads to development which, in turn, leads to demonstration and eventual commercialization of coal utilization and combustion techniques. Very directly, the CRSC's work impacts the energy and environmental future of Illinois and the nation.

Richard Shockley, director of the Center for Research on Sulfur in Coal (CRSC).

Q. What is the basic benefit of clean coal research?

A. Illinois has 30 billion recoverable tons of coal which at $25 per ton could produce $750 billion in potential revenue. However, to generate the revenue will require the development of technology that will allow Illinois coal to compete on a cost and environmental basis with other fuels, including nuclear. Basic research provides the foundation for these new technologies to progress to the commercially marketable level. ✦

Illinois Coal Development Park in Carterville, Illinois.

Illinois Department of Energy and Natural Resources
Office of Coal Development and Marketing
325 West Adams, Room 300
Springfield, IL 62704-1892

Illinois coal Update

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing
John S. Moore, Director; Jim Edgar, Governor

- **$1 Billion Level Reached in Illinois**
  Through combined efforts, Illinois continues to advance CCT research and demonstration.
- **Technology Up Close**
  The HSA Hydrated lime, produced from Illinois limestone, results in outstanding test results.
- **Coal: The Shape of Things to Come**
  Clean coal technologies will provide an environmentally clean energy source.

Printed by Authority of the State of Illinois.
Printed on recycled and recyclable paper.
(X20471-10M-4/92)

Illinois Coal Update

ILENR/CD-90/02(92-2)

ENR Illinois Department of Energy and Natural Resources

Volume 3, Number 2 1992

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

Illinois: Accessing Worldwide Coal Markets

The Illinois Department of Energy and Natural Resources (ENR) has launched a new service to help state coal producers tap into the international coal market. EXILLNET (EXport ILLinois NETwork) provides opportunities for coal producers and ENR to work together to broaden the market for Illinois coal.

"The EXILLNET service will help build a global market for Illinois coal by putting many international marketing tools into one convenient package," said Carol Rowe, ENR's manager of coal marketing and demonstration. EXILLNET is compiled of a seven-volume database listing coal consumers, coal-fired utilities and plants, coal-fired units and profiles of the coal market and coal buyers from countries worldwide.

The Illinois Coal Development Board approved funding for the ENR program, which is operated in cooperation with the Illinois World Trade Center in Chicago. "Initial reaction from the coal companies about EXILLNET has been overwhelmingly positive," says Rowe.

EXILLNET combines several services. First, EXILLNET identifies potential coal markets abroad for Illinois coal and other potential Illinois exporters, such as clean coal technology companies. Second, the network provides vital information needed to develop international trade packages that combine the sale of coal with appropriate incentives. Third, EXILLNET data can be used to develop an international strategy to market Illinois coal. Fourth, through the World Trade Center, EXILLNET offers an international communications channel to help complete coal sales.

Today, the Illinois coal industry is the second-largest downstate industry and ranks fifth in the United States for coal sales. For many years, high-Btu Illinois coal has been the fuel of choice at utilities in more than a dozen states. To help producers expand their markets beyond the domestic plane, EXILLNET helps coal companies promote Illinois coal and value-added services to prospective customers across the world. As Jan M. Grayson, director, Illinois Department of Commerce and Community Affairs, explains in the state's Economic Impact report, "If the state were a nation, Illinois would rank (worldwide) as the 'nation' with the 13th largest Gross National Product."

In fact, the Mississippi Valley Coal Exporters Council reports that overseas coal exports from the United States alone totaled 97.3 million short tons in 1991. This places the United States second behind Australia, which holds the top spot in the coal export market. Judging by current market trends, the Council predicts that U.S. export shipments will increase more than 15 percent in 1992.

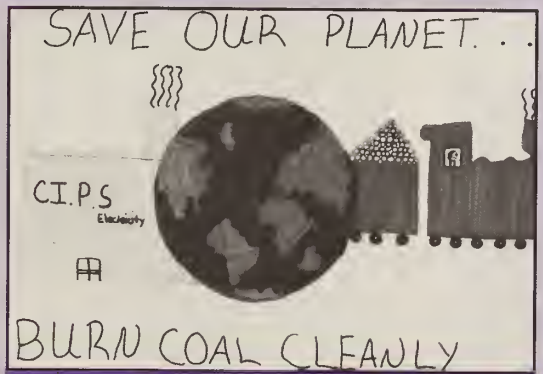
As a result of the 1990 Clean Air Act amendments, Illinois could lose 25 to 40 percent of its annual coal sales, or nearly $575 million. The EXILLNET tool can assist Illinois coal companies aggressive pursuit of foreign markets, which will help sustain coal sales and protect many mining jobs in Illinois.

On the bright side, opportunities created by the changing economies in the European community and the former Soviet Union have made the international market for coal more accessible than ever, which is important to Illinois coal producers. In addition, the growing overseas market looks promising since coal is the fuel source for more than half the world's electric utilities. Decisions by overseas utilities to build new coal-fired plants by the year 2000 will improve market opportunities for Illinois coal.

The EXILLNET service will help coal producers break into or expand their businesses in the growing international marketplace by developing new opportunities for Illinois' most valuable and abundant natural resource. ✦

Coal: Through the Eyes of a Child

More than 650 students from fifth and sixth grade classes from Illinois schools created posters and essays to compete in the fourth annual "Energy and the Environment: Words and Pictures About Illinois Coal" contest this year. The contest is co-sponsored by the Illinois Department of Energy and Natural Resources (ENR) and Southern Illinois University at Carbondale to emphasize the state's commitment to educating children on the importance of coal, energy and the environment.



Drawn by Tiffany L. Vantiger of Pontoosuc, Illinois, Dallas Community Elementary School. Her sixth grade teacher is Carolyn Phillips.

From this year's record number of entries, 25 winners were awarded $50 Series EE Savings

(continued on page 2)

"The system is expected to reduce SO_2 emissions by 50 percent and NO_X emissions by 60 percent."

Testing to Begin On Technology For SO_2 And NO_X Reduction

Site preparation is under way in Springfield, Illinois, the host location for testing a clean coal technology (CCT) designed to control emissions more efficiently and at less cost than conventional flue gas scrubbers. The project promises good results toward the reduction of sulfur dioxide and nitrogen oxide pollutants.

City Water, Light & Power (CWLP), the public utility in Springfield, will demonstrate a gas reburning-sorbent injection system, or GR-SI technology, that will be adapted to the utility's 40-megawatt Lakeside Station Number 7 Unit. The boiler being retrofitted for GR-SI was installed in 1959.

A sorbent silo erected during site preparation for the new GR-SI technology demonstration at the Illinois Power plant.

As the name implies, GR-SI is a two-step system that burns pulverized coal and natural gas. Natural gas is injected into the boiler above the coal flame. This process reduces more than half of the nitrogen oxides (NO_X) formed in the combustion zone of the boiler and converts them to harmless nitrogen gas. Air is then added to re-burn the remaining combustible gases. In the second part of the process, a limestone sorbent is injected into the upper part of the boiler. Through a chemical reaction inside the boiler, the limestone "captures" sulfur dioxide (SO_2) particles to form a calcium sulfate-type solid that will be removed by the existing precipitator.

The system to be demonstrated is expected to reduce SO_2 emissions by 50 percent and NO_X emissions by 60 percent.

Attractive for its fuel efficiency, GR-SI also has modest capital costs because the system retrofits existing boiler equipment. Unlike first-generation or advanced scrubbers, GR-SI is a combustion-centered system that requires minimal space at a power station.

Energy and Environmental Research Inc. (EER), of Irvine, Calif., is the technology supplier for the project. The project includes a companion effort GR-SI testing on another boiler design at Illinois Power Company's Hennepin, Illinois, station. Early test results at Hennepin show a 77 percent reduction in NO_X emissions and a 62 percent reduction in SO_2.

Cost of the Springfield GR-SI demonstration project is more than $12 million, which is being shared by the Illinois Department of Energy and Natural Resources, the U.S. Department of Energy's CCT program and the Gas Research Institute.

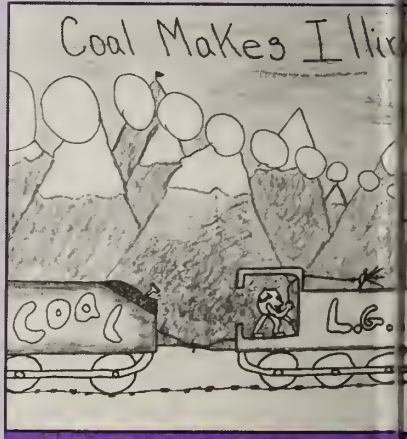
Testing of the GR-SI CCT project will continue into 1993. ✦

Eyes of a Child

(continued from page 1)

Bonds, a certificate from Governor Jim Edgar, and will be sent complimentary copies of the popular 1993 "Words and Pictures About Illinois Coal" calendars featuring the award-winning artwork and essays. The winners' teachers also received certificates from Governor Edgar, a letter from John S. Moore, director, ENR, and will be sent the 1993 calendars for display in the classroom. To date, 100 winners have been selected in the four-year period since the contest originated.

In addition, all winning students and their teachers are invited to participate in the Coal Awareness Week (October 18-24) festivities on October 21 at the Illinois Coal Development Park in Carterville, Illinois.



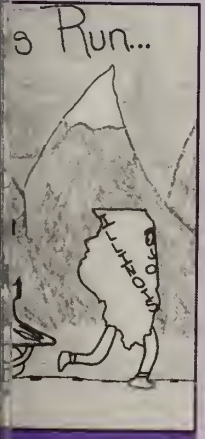
Drawn by P. J. Kalb of Warrenville Warrenville Middle School. His si Kat Gaynor.

Drawn by Rachel M. Hooton of Wheaton, Illinois, Wheaton/ Warrenville Middle School. Her sixth grade teacher is Kat Gaynor.

The students' winning posters and essays will be showcased in two unique 1993 calendars that are distributed free nationwide. One calendar is a colorful poster that includes a montage of the artwork from 13 award winners. The second calendar is a month-by-month wall calendar featuring different essays and artwork each month.

"These calendars do an impressive job of promoting the positive image of coal from a child's point of view," says Moore. "We're very proud of this educational outreach program. It's important that children throughout Illinois learn about the advantages of Illinois coal and how this valuable natural resource is closely tied to energy and a better environment."

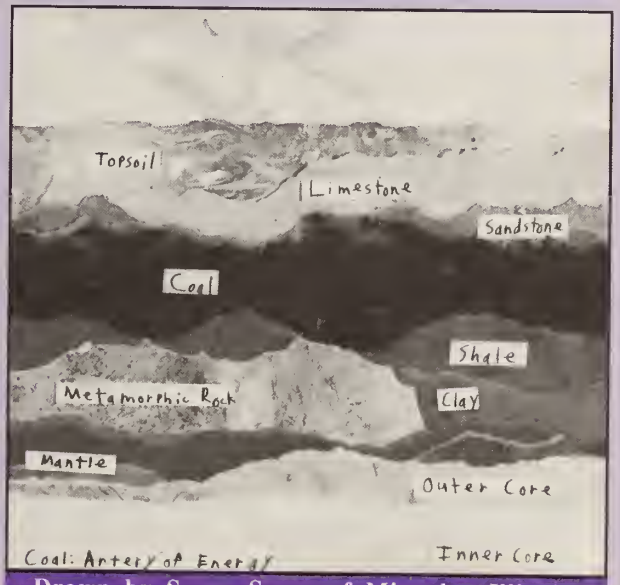
Each month, the colorful artwork and insightful essays in the calendars will illustrate what the students have learned about coal and their environment through a creative education program sponsored by ENR. Through this fun, educational program, students are learning that coal, the state's most abundant resource, can be a safe and environmentally favorable energy source for the future.



nois, Wheaton/ rade teacher is

Coal mining is the state's second largest downstate industry. However, the ENR program reaches children from all over Illinois. "We are pleased that students throughout the state are enthusiastically learning about coal and participate in the contest each year," says Shelia Sapetti, public information officer for ENR's Office of Coal Development and Marketing. "In fact, many of the award winners this year were from northern Illinois communities, such as Roscoe,Wheaton/ Warrenville and LaHarpe."

The 1993 calendars will become available in the fall. Calendars are available free while supplies last. To order a 1993 "Words and Pictures About Illinois Coal" calendar, write the Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing, 325 West Adams Street, Room 300, Springfield, Illinois 62704-1892, or call 217/782-6370, (Illinois residents can call ENR's Information Clearinghouse toll-free at 1-800-252-8955). ✦



Drawn by Suren Seron of Minooka, Illinois, Minooka Junior High School. His sixth grade teacher is Mrs. Van Duyne..

"The Illinois Clean Coal Institute directs a broad range of research on the structural and thermal conversion characteristics of coal."

Coal Research: Bridging Today With Tomorrow

By Kim Underwood, Director, Office of Coal Development and Marketing Illinois Department of Energy and Natural Resources

We live in the Age of Information -- a time when science produces important discoveries that benefit the quality of our lives almost faster than we can stay informed of them.

Those of us involved with coal research are amazed at how much we continue to learn about a natural resource that dates back more than 200 million years. Time has yet to unleash all the lessons about coal, as each new revelation expands coal science in exciting new directions.

For that reason, the Illinois Department of Energy and Natural Resources has adapted its approach toward the science of coal. The Center for Research on Sulfur in Coal, created in 1982 to administer statewide coal sulfur research, will expand its research and be renamed the Illinois Clean Coal Institute.

The new name characterizes the Institute's expanded mission, a mission that reaches far beyond the sulfur properties of coal to the vital concepts of energy and the environment. Along with continued study of sulfur removal, the Institute directs a broad range of research on the structural and thermal conversion characteristics of coal, efficiency, and environmental issues.

Presently, the Illinois Clean Coal Institute supports 43 basic research projects with a budget of $3.75 million. The Institute serves as a scientific launching pad that propels basic research into advanced technologies using coal to produce safe, efficient and environmentally sound energy. Efforts have been directed toward demonstrating greater energy security and enhanced environmental quality are mutually compatible goals achievable through the use of clean coal technologies.

Solutions begin with quality scientific research, and that's where the Institute excels. The Institute is Illinois' continued commitment to the advancement of a vital natural resource that will play a key role in the future of our state.

A prime example of the Institute's work is the high-surface-area hydrated lime sorbent technology (*Illinois Coal Update*, Volume 3, Number 1). This technology enhances a natural resource--basic Illinois limestone--to capture sulfur dioxide gas emissions from coal-fired boilers. Aided by the Institute and several state agencies, this technology has moved from the chalkboard to near-commercialization in the span of a few years.

Other research projects supported by the Illinois Clean Coal Institute dot the Illinois map. Each location could be the site of the next great discovery about coal and its many mysterious and valuable properties that are as old as time itself.

Institute Director Richard Shockley and his staff of eight evaluate research proposals, award grants and monitor each project to completion. State agencies, non-profit research centers and Illinois' fine colleges and universities are recipients of these grants. The Institute also attracts some of the top coal, energy and environmental experts in the world to do basic coal research in Illinois.

So, while coal has been around since the days of the dinosaurs, we're just beginning to tap its potential. Our own nation has mined coal for more than 150 years and burned it to fuel the Industrial Revolution. The United States, in fact, has enough recoverable reserves to produce energy for the next 500 years.

Meanwhile, continued coal research such as that made possible by the Illinois Clean Coal Institute brings us closer to an understanding of the origins and future potential of the world's most abundant natural resource.

Today, scientists who are backed by the Illinois Clean Coal Institute are unlocking natural mysteries as they develop more marketable uses for Illinois high-sulfur coal, which will keep coal in the forefront of the nation's energy picture. Ultimately, coal research will improve the quality of our lives and the environment for many generations to come. ✦

Kim Underwood

"Clean coal technologies will be the backbone of power generation in the future."

Jack Siegel: DOE's CCT Program

The U.S. Department of Energy (DOE) funds research, development and demonstration projects to develop cleaner, more efficient uses for coal in the wake of the Clean Air Act and with the threat of actions related to global climate change. Jack Siegel, Deputy Assistant Secretary for Coal Technology, Office of Fossil Energy, U.S. Department of Energy, was recently interviewed about the nationwide program and its connection with Illinois clean coal initiatives. Mr. Siegel has been with the office since its inception in 1986.

Q. Explain the goals of DOE's clean coal technology (CCT) program.

A. The U.S. Department of Energy's CCT program conducts: research, development and demonstrations to enable coal to remain a viable option in the future. The research and development program, which has been in place for more than 20 years, involves cost shared projects with industry, universities and states in order to find ways to use coal more cleanly, efficiently and economically.

The program has three basic thrusts. First, in conjunction with power generators and manufacturers of developing technologies, DOE is working to ensure that coal will continue to be used by electric utilities in compliance with federal emissions standards.

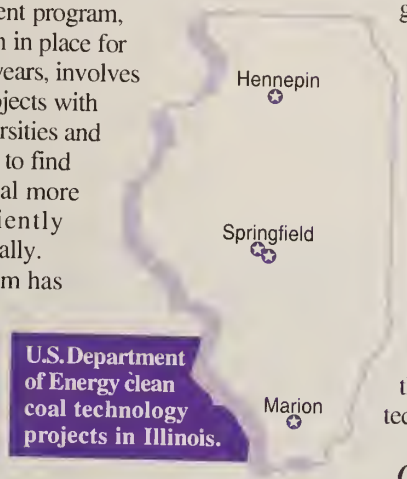
The second element of the program is to develop coal-based technologies to produce fuels needed to reduce our dependence upon imported oil. The department is developing technologies to process coal into a high-quality liquid transportation fuel to compete with oil being imported into the United States.

The third element of DOE's clean coal program is to demonstrate the technologies at full commercial scale and provide assistance to industry to commercially deploy them.

Q. DOE sponsors the gas reburning-sorbent injection system (GR-SI) and the integrated gasification combined cycle (IGCC) projects in Illinois. What is the value of these two projects?

A. The GR-SI project is among the developing technologies that utilities will use to comply with the Clean Air Act amendments of 1990. It is pollution-control technology which gives electric utilities a low-cost option to reduce sulfur dioxide and nitrogen oxide emissions from existing plants. Early results from the Hennepin, Illinois, testing site have exceeded expectations.

IGCC technology can achieve greater than 98 percent sulfur dioxide control and 95 percent nitrogen oxide reduction which will meet very stringent system environmental requirements very efficiently. These results approach the emissions levels at power plants that burn natural gas. The IGCC technology can be up to 40 percent more efficient than existing combustion technologies.



U.S. Department of Energy clean coal technology projects in Illinois.

Q. What are your overall thoughts on the Illinois clean coal technology program?

A. Clearly, Illinois is a leader in advancing clean coal technologies. The state had the foresight to recognize that coal is an important energy source and that environmental restrictions would put CCTs in the technological spotlight. The Illinois CCT program is an integral player in the national campaign to promote advanced methods of producing safe, reliable energy with coal.


Jack Siegel, Deputy Assistant Secretary for Coal Technology, Office of Fossil Energy, U.S. Department of Energy.

Q. How has the Clean Air Act changed the focus of the national CCT program?

A. Since the Clean Air Act was enacted, DOE has focused on technologies which will be required to allow coal to compete beyond the year 2000. Up to 1990, the principal emphasis was on existing coal-fired plants and finding the least expensive way for these plants to comply with acid rain provisions. Clean coal technologies will be the backbone of power generation in the future.

Q. What do you anticipate for the next round of federal CCT funding?

A. In CCT-V, the department will take a further step toward encouraging the demonstration of super clean and efficient technologies and other technologies, such as liquefied coal, which will become very important after the year 2000. ✦

Illinois Department of Energy and Natural Resources
Office of Coal Development and Marketing
325 West Adams, Room 300
Springfield, IL 62704-1892

Illinois coal Update

ENR Illinois Department of Energy and Natural Resources

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

- **Illinois Accessing Worldwide Coal Markets**
  A newly developed international service will inform and help complete coal sales.
- **Coal: Through the Eyes of a Child**
  A look at the state's commitment to educate children on the importance of coal.
- **Coal Research: Bridging Today With Tomorrow**
  Research goals are expanded at the newly named Illinois Clean Coal Institute.

Printed by Authority of the State of Illinois.

Printed on recycled and recyclable paper.

X20471 - 10M - 7/92

Illinois Coal Update

ILENR/CD-90/02(92-3)

ENR Illinois Department of Energy and Natural Resources

Volume 3, Number 3 1992

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

New Directions in Coal Research

A decade ago the Center for Research on Sulfur in Coal (CRSC) was formed in Illinois to research sulfur and other noxious elements in Illinois coal. However, the winds of change, blown mostly by the federal Clean Air Act (CAA) amendments of 1990, have changed the course of research for the Center.

Today, the newly named Illinois Clean Coal Institute (ICCI) reflects the program's new mission of energy research for a cleaner environment.

"The 1990 Clean Air Act amendments have moti- vated coal researchers to be more aggressive in developing clean coal technologies for commercial scale operations," says Richard Shockley, director of the Institute. "Therefore, we have changed our name to reflect this new challenge."

New clean coal technology (CCT) applications will help Illinois reach two important goals. They will create and improve technologies for a cleaner environment, and enhance the marketability of Illinois' high-sulfur coal. ICCI is responsible for all state coal-related programs, including coal research, industrial utilization efforts, development and demonstrations.

The heart of the Illinois Clean Coal Institute beats in the Illinois Coal Development Park in Carterville, Ill., where it pumps funding into projects mainly at colleges, universities and research organizations statewide. ICCI is governed by the Illinois Coal Development Board (ICDB) which is housed administratively at the offices of the Illinois Department of Energy and Natural Resources (ENR).

ILLINOIS CLEAN COAL INSTITUTE

Energy Research for a Cleaner Environment

Each year, based on recommendations from the ICDB, the Illinois Clean Coal Institute awards grants to public, private and university organizations primarily within Illinois. ENR's Office of Coal Development and Marketing and the U.S. Department of Energy provide funding for the program. Fiscal year '92 funding includes $3.5 million in grants to coal research projects in the areas of cleaning, characterization, combustion, fuels and chemicals derived from coal, gas cleanup and related studies.

Central to ICCI's guiding philosophy is the belief that basic coal research is the starting point for finding more efficient and effective clean coal technologies. Ideas developed in laboratory settings are the birthplace of technologies that ultimately rest on commercial demonstration.

Commercial application often leads to utilization of large-scale clean coal technologies that provide energy efficiently and help produce a cleaner environment. ✦

"It's our responsibility to educate young people about the role that coal plays in shaping our nation's energy supply and the environment."

Coal Awareness Week Focus Is To Educate Kids

Presenting a better understanding of the environment and the advantages of coal to Illinois children was the goal of the fourth annual Coal Awareness Week in Illinois. Coal Awareness Week 1992 was celebrated October 18-24 at the Illinois Coal Development Park in Carterville, Illinois.

Louie the Lightning Bug with some of the 700 school children attending Coal Awareness Week activities.

On October 21, more than 700 school children from throughout the state met at the Coal Park to learn firsthand the importance of coal mining in Illinois, and how coal can be used as a clean, environmentally safe fuel resource. During the week, classrooms across the state had the opportunity to view a newly created education video, "Kids, Coal and the Environment." The video, produced by the Illinois Department of Energy and Natural Resources (ENR), was prepared for use in classrooms and is available by calling ENR at 217/782-6370.

"For the fourth consecutive year, the Illinois Department of Energy and Natural Resources will be providing a creative learning environment for children, says John S. Moore, director of ENR. "Through Coal Awareness Week, and activities such as the "Words and Pictures" contest, we have seen coal awareness increase among Illinois school children."

Also on October 21, a special presentation was held for children who are 1992 winners of the contest titled "Energy and the Environment: Words and Pictures About Illinois Coal." Those students were honored before an audience of their peers at the Coal Awareness event.

The contest, co-sponsored by ENR and Southern Illinois University, emphasizes the state's commitment to educating children about the importance of coal, energy and the environment.

"Illinois has a proud history of four generations of coal mining, and it's our responsibility to educate young people about the role that coal plays in shaping our nation's energy supply and the environment," says Moore.

Coal Awareness Week activities are free and open to the public. ✦

Some of the 1992 winners of the "Energy and the Environment: Words and Pictures About Illinois Coal" calendar contest with state Senator Ralph Dunn and Secretary of State George Ryan.

History, Goals of Illinois Coal Development Board

Porter Womeldorff and Senator Ralph Dunn, the two longest-standing members of the Illinois Coal Development Board, were interviewed recently by Illinois Coal Update to discuss the past and future of the board. As vice president at Illinois Power Company, Womeldorff is in charge of environmental counseling and engineering planning. Senator Dunn (R-DuQuoin) has been in office since 1973.

Q. What was the original charter of the Illinois Coal Development Board in 1982?

A. Womeldorff: We set out initially with several important goals in mind. One, the board was chartered to improve coal research activities at various state institutions and universities in Illinois. Two, a principle focus in 1982 was to increase funding in coal sulfur research. But in hind-

Coal Board Has New Members

The Illinois Coal Development Board, which oversees state-sponsored research, development and demonstration programs of clean coal technologies, was the subject of an Update report in 1991 (Volume 2, Number 4). Since that time, the board has added two new appointees to its 11 person board.

Porter Womeldorff, vice president at Illinois Power Company

sight, one of the best policies instituted was the establishment of the "coal sample bank" at the Illinois State Geological Survey to ensure that all common materials used in research come from this source.

Q. How has the role of the Illinois Coal Development Board changed?

A. Dunn: The board changed its name, for example, from the Coal Research Board to the Illinois Coal Development Board to emphasize our focus on both research on sulfur in coal and the board's expansion into coal technology programs. One of our first significant changes was to recognize that the board was not in a position to fully monitor research, so the Center for Research on Sulfur in Coal was established. Just recently the name of the Center was changed to the Illinois Clean Coal Institute. The new name reflects that, while sulfur in coal remains an important issue, there are other issues related to burning coal.

Q. What do you consider some of the board's greatest accomplishments?

A. Womeldorff: I consider the board's three major accomplishments to include the establishment of a coal sample bank, cooperation with the state administration and legislature to keep the coal program going during tough, economic times, and the moving of clean coal technology projects toward commercialization.

Dunn: The states that produce high-sulfur coal were penalized with the passage of the Clean Air Act. To combat this, the board aggressively pursued federal funding to implement programs to counteract acid rain legislation. To date the board has been successful in capturing more than $1 billion in funding from a combination of federal dollars, matching state funds and private industry. Perhaps one of our biggest accomplishments was the development of the Illinois Coal Development Park to house research activity and to serve as an educational center for Illinois residents.

Q. What decisions does the board face in the near future?

Honorable Ralph Dunn, in office as state senator for Illinois since 1973.

A. Womeldorff: The board's greatest challenge will be to position Illinois as an effective coal supplier in the first two decades of the 21st century. With the Clean Air Act provisions, the board must ensure that coal has its proper position in the energy mix of this country. The real challenge is to find unconventional solutions for using Illinois coal post-2000.

Dunn: Two of the main challenges facing the board are to keep state funding at the same level amid stringent budget cuts. Global warming is also a great concern, and the future of Illinois coal may lie in developing alternative methods for using coal. The Illinois Coal Development Board will be exhausting all possibilities to make coal a viable energy alternative in the years to come. ✦

Richard Brooks has worked his way up through the ranks to his present position as president of Freeman Resources Inc., located in Marion, Illinois. Before joining Freeman in 1976, Brooks held various posts with Westmoreland Resources and with Consolidation Coal Company. He is director of the finance committee for the National Coal Association, former chairman of the Mississippi Valley Coal Exporters Association and a member of the Illinois Coal Association, the Rocky Mountain Coal Mining Institute, the King Coal Association and the Chicago Coal and Traffic Exchange.

Linda Denton is a physics instructor at Rend Lake College in Ina, Illinois. Prior to joining the Rend Lake College staff, she was a lab technician at Southern Illinois University-Carbondale's Department of Thermal and Environmental Engineering. She also has been a civil engineer with the firm of Barttelbort, Rhutasel & Associates in Freeburg, Illinois.

Continuing board members include:

John S. Moore, chairman, ICDB; director, Illinois Department of Energy and Natural Resources

Honorable Ralph Dunn, State Senator

Honorable David Phelps, State Representative

Jan M. Grayson, director, Illinois Department of Commerce and Community Affairs

Ron Morse, director, Illinois Department of Mines and Minerals

Carolyn J. Ehlert, manager, Illinois Legislative Affairs, Deere & Co.

Edgar Hale, Captain Mine, United Mine Workers of America

Richard E. Newtson, vice president, A.G. Edwards and Sons, Inc.

Porter Womeldorff, vice president, Illinois Power Company ✦

"It's a win-win situation for Rochelle and Illinois coal."

Technology Up Close: Micronized Coal

With a new retrofit clean coal technology (CCT) project well underway, the Rochelle Municipal Utilities' power plant will soon begin testing Illinois coal as its primary fuel source.

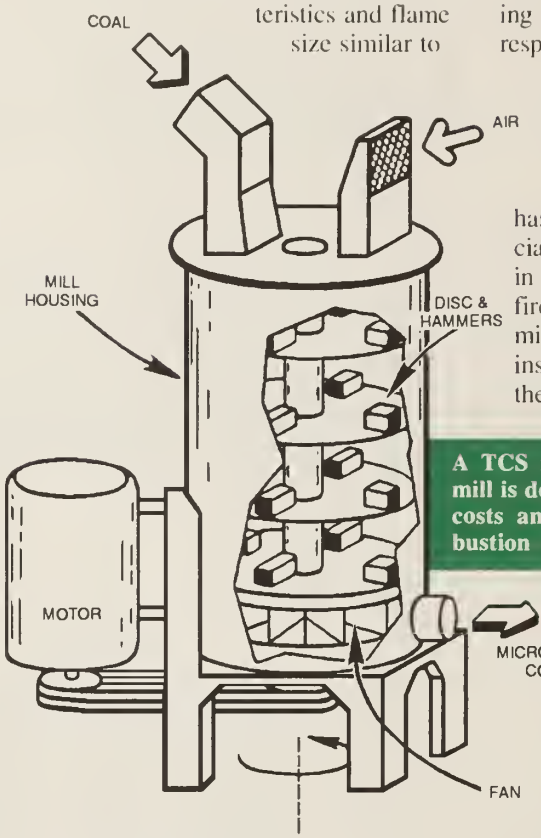
Originally designed to burn both gas and coal in the early '60s, the Rochelle plant was converted totally to natural gas in the late 1980s. With funding provided by Rochelle and the Illinois Department of Energy and Natural Resources, financing and planning began in mid-1991 to build a retrofit system that could burn Illinois coal while lowering air pollution emissions. The Rochelle plant is an 11.5 megawatt electric/steam cogeneration facility, located 75 miles west of Chicago and servicing up to 6,000 customers.

Plans call for Illinois high-sulfur coal to once again fuel the power plant beginning in early 1993, when the $18 million project is scheduled to start operations. The project will then embark on a two year demonstration program.

"The state's strong commitment to the clean coal technology program was a driving force behind Rochelle's decision to pioneer this new technology and return to using Illinois coal," says Ray Schwartz, general manager of Rochelle Municipal Utilities.

Rochelle's new retrofit TCS micronized coal system is designed to reduce operating costs and improve combustion efficiency, while using high-sulfur Illinois coal and various Illinois limestones. Co-micronizing these two elements is expected to reduce sulfur dioxide (SO_2) and nitrogen oxide (NO_x) emissions by 50 percent.

TCS, Inc., of Oakland, Md. holds the U.S. patents for the TCS micronized coal combustion system. The retrofit project includes four micronized coal mills which are similar in size to 55-gallon drums, standing 48 inches high and measuring 40 inches in diameter. The mills reduce coal particles to a "talcum powder" consistency. The average particle diameter is about 17 to 20 microns, or about one-half the diameter of a human hair. Micronized coal has combustion characteristics and flame size similar to oil, thus enhancing the dual-fuel capability.



A TCS micronized coal mill is designed to reduce costs and increase combustion efficiency.

The dust-like particles are then blown into an exiting air flow and conveyed directly into one of four TCS low-NO_x dual-fuel (micron coal and gas) burners to control nitrogen oxide. The retrofit project also includes three new coal and limestone storage handling units, two new baghouse units and new monitoring equipment, as well as upgrading of existing controls.

"The Rochelle project will have the potential advantage of using raw limestone rather than more expensive processed lime sorbents used by other clean coal technologies to control SO_2 emissions," says Tim Lanager, president of TAS Coal Systems (TCS) Inc. and prime contractor for the Rochelle project.

In addition, the new retrofit system will lessen the facility's dependence on natural gas, provide Rochelle with the potential of "opting in" for SO_2 allowance credits in response to the 1990 Clean Air Act, and possibly create a marketable ash by-product. Says Schwartz, "It's a win-win situation for Rochelle and Illinois coal."

Micronized coal can and has been successfully and commercially fired in other gas/oil boilers in addition to conventional coal-fired units. More than 90 TCS micronized coal mills have been installed in industrial facilities in the United States and overseas.

"Since Rochelle is the first commercial utility to install the micronized coal system, other countries are keeping a watchful eye on this project," says Guy Gilbert, project engineer at the Illinois Department of Energy and Natural Resources. Representatives of Czechoslovakia and Poland have already inquired about the Rochelle project and are interested in this technology for their own coal-powered facilities.

"Not only is this retrofit project good for Illinois," says Gilbert, "but we can export some of Illinois' clean coal technology expertise to help other countries, too." ✦

"The U.S. took a prudent approach in refusing to join the 'sky is falling' environmental bandwagon in Rio."

Compromise: Coal After Rio

By Kim Underwood, Director, Office of Coal Development and Marketing Illinois Department of Energy and Natural Resources

Patience, it is said, is a virtue. Certainly the coal industry, particularly the Illinois high-sulfur coal industry, has shown patience approaching the biblical proportions of Job in withstanding the overly aggressive stance of environmentalists in the summer of '92.

By the time the United Nations Conference on Environment and Development (UNCED) convened in Rio de Janeiro in June, it had become the ecological cause of the decade. Months of on-hands promotion of the so-called "Earth Summit," disseminated by friendly and receptive media, had laid the groundwork for what proponents heralded as the cornerstone for a New Age philosophy.

Business and the world's governmental superpowers would acquiesce to the notion that only drastic measures could rescue Earth and our descendants from wanton destruction.

Not exactly.

While motivated by such noble goals as saving the Earth's diverse ecostructure and paving the way to a kinder, gentler future, some more ardent proponents of a New World Order seemed to foster a herd mentality to approve their stringent measures, rather than setting up a debate where all interested parties could bring their concerns and questions to a world forum for discussion.

By refusing to be stampeded by emotion, listening instead to the voices of scientific, environmental and economic reason, the United States helped shape the outcome of the Earth Summit so that, in the words of NEWSWEEK, "eventually Rio will be seen as a triumph of enlightened diplomacy. Even the U.S. position will someday be praised."

Compromise played a major role in the final pronouncements from Brazil. Agenda 21, a non-binding blueprint for action, contains the seeds for at least two dozen environmental projects which would foster "sustainable development," defined as 'progress without destruction of the environment'. Rather than set up business and environmental forces in a confrontational shootout, sustainable development looks to merge the two forces for a common goal that benefits all.

Improving energy efficiency is a key element of Agenda 21. Clearly, the research, testing and development of clean coal technologies (CCT) in the United States -- a field led by Illinois since the 1970s -- should bring CCT's to the forefront of the environmental crusade.

Additionally, control of greenhouse gases -- another focal point for the summit -- will be accomplished mainly by energy efficiency. NEWSWEEK notes correctly that this is an economic positive, rather than the negative business impact that would result from any loss of jobs caused by abrupt curtailment of greenhouse gas emissions.

Really, the posture taken by the American government and President George Bush helped to define the Earth Summit and give it a more lasting shape. One of the five major documents that resulted at the Rio convention, and the only one of two legally binding agreements signed by the United States, is the Climate Change Convention.

For the first time in history, nations must consider global environmental consequences that may result from their own national economic policies. We have seen how "human rights" violators can be ostracized on the worldwide U.N. platform for not adhering to the Helsinki Summit agreements of 1975. In similar fashion, this document outlines plans for developed countries to follow to gradually diminish greenhouse gas emissions.

Several of the points in this agreement, which was termed a "compromise" between the "rigid commitment" forces led by Europe and the more flexible posture of the United States and some others, touch on the importance of new technologies in stemming greenhouse gases.

Certainly, clean coal technologies will bring about more efficient and environmentally sound burning of coal. And bringing those technologies to developing countries will further extend the reach of CCTs and further the impact of the Climate Change Convention.

The United States took a prudent approach in refusing to join the "sky is falling" environmental bandwagon in Rio, an approach that will work in the long run for this country, this state and the entire world. ✦

Kim Underwood

Illinois Department of Energy and Natural Resources
Office of Coal Development and Marketing
325 West Adams, Room 300
Springfield, IL 62704-1892

Illinois coal Update

Illinois Department of Energy and Natural Resources. Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

- **New Directions in Coal Research**
  Clean Air Act amendments of 1990 change course of research.
- **Coal Awareness Week in Illinois**
  Debut of newly created education video, "Kids, Coal and the Environment".
- **Compromise: Coal After Rio**
  Improving energy efficiency is a key element of Agenda 21.

Printed by Authority of the State of Illinois.
Printed on recycled and recyclable paper
X0394AA - 10M - 12/92

Illinois Coal Update

ILENR/CD-90/02(93-1)

ENR Illinois Department of Energy and Natural Resources

Volume 4, Number 1 Spring 1993

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director, Jim Edgar, Governor

"Kids, Coal and the Environment," a Video "Hit"

Art Linkletter used to showcase kids who would say the darndest things. In Illinois, kids are telling other kids the latest things about coal, its history and its uses. The message seems to be taking hold.

That message is being sent via a video called "Kids, Coal and the Environment," produced by the Illinois Department of Energy and Natural Resources' (ENR) Office of Coal Development and Marketing. The 9-minute film tells the story of coal in a lively, informative way, with music, live footage and colorful illustrations. Aimed at school children in the 5th and 6th grades, the video's "stars" are Illinois kids. More than 400 schools and classes have requested and received the video to date.

Students from a number of grade schools, including LaHarpe Elementary School, Sesser/Valier School, Ewing Northern Elementary School and Elkhart School, participated in the educational project. As hosts of the film, they asked and answered questions such as how coal is formed, mined and delivered, what is being done to protect the environment and what safety precautions are taken for coal miners. Kim Underwood, director of the Office of Coal Development and Marketing, believes that the presentation helps students and teachers understand the importance of coal to Illinois. "The video emphasizes the importance not only of Illinois' most abundant natural resource but of the critical connection between clean coal and a safe environment," says Underwood.

In simple and understandable terms, the video story unfolds. Coal began its evoluation millions of years ago during the days of dinosaurs, when plants died and fell to the bottom of the water-soaked, swampy earth. Layers formed, decomposed and finally "squeezed eight feet of material into one foot of coal."

Cameras take the viewer underground to where coal is mined, using either the room and pillar method — or the long-wall mining method.

Safety is a primary concern and the students display gear that miners wear and use to protect themselves. Student actors show what happens to the coal after it's mined and how it is delivered by barges and rail cars to its destination.

While most students are aware that coal is used to generate electricity, many of them are surprised when seeing the video to learn that coal is also found in aspirin, perfume, soap, fertilizers and a host of other products.

"Kids, Coal and the Environment" is akin to a Hollywood undertaking for the Department of Energy and Natural Resources. "We wanted to tell the story of coal to the children of Illinois in a way they would find interesting and fun," says Underwood. "ENR places a high priority on education, and the video complements our existing education materials," he adds.

The production crew turned its bright lights onto 10 different locations, including coal mines, power plants and schools in southern Illinois during the course of the one-month shooting. Children from neighboring communities made the project a success.

Illinois is the nation's fifth largest producer of coal and, as the video says, with clean coal technologies at work, it will provide the energy needed for the 21st century when children viewing the video will become decision-makers. After all, the video project is dedicated to them —"To the children of Illinois who will shape the future of coal, energy and the environment."

Schools may request "Kids, Coal and the Environment" on a loan basis or a free copy, if available, at no cost by calling the ENR Clearinghouse at 1-800-252-8955. For TDD customers, call 1-800-526-0844 (Illinois Relay Center). ✦

"While a number of options are available to utilities, it appears likely that purchases of Illinois coal will drop approximately 17 percent from 1992 levels..."

Phase I Compliance Hits Illinois Coal

By Kim Underwood, Director, Office of Coal Development and Marketing Illinois Department of Energy and Natural Resources

Ever since former President George Bush signed the federal Clean Air Act amendments of 1990 into law, the high-sulfur coal industry in the United States has looked warily toward 1995.

That's because Phase I of Title IV provisions of the Clean Air Act takes effect in 1995 when sulfur dioxide emissions must be limited to 2.5 pounds per million Btus. In order to meet that requirement, 24 of the 34 utilities which consumed Illinois coal in 1992 will need to make adjustments to their energy picture. Those 24 utilities currently operate at least one boiler each which emits sulfur dioxide exceeding the Phase I mandate.

While a number of options are available to those utilities, it appears likely that purchases of Illinois coal will drop approximately 17 percent from 1992 levels as utilities opt to switch to low-sulfur coal rather than scrub. For an industry that has been reeling from various knocks dealt it by a sluggish economy, such a decline further aggravates an increasingly serious condition.

The Illinois Coal Development Board's "Outlook for the Illinois Coal Industry," published this spring, devotes an entire chapter to analyzing compliance plans of the 34 utility customers of Illinois coal who are compelled to respond to the mandates of Phase I and the even more challenging dictates of Phase II, which comes around in the year 2000. For the 24 utilities requiring sulfur dioxide emission reductions in 1995, seven options are considered.

Those options include (1) installation of pollution control devices, or scrubbers, (2) use of lower-sulfur content or compliance coal, that is, fuel switching, (3) purchase of allowances, (4) switching to an alternative fuel, (5) closing units, (6) offsetting emissions at one plant by overcomplying at another, or (7) a combination of options.

Nine utilities appear poised to cut back significantly on their purchase of high-sulfur Illinois coal by 1995. By 1995, it is estimated by the Illinois Coal Development Board that tons of Illinois coal sold to utilities will decrease to 45,397,000 tons.

As pessimistic as that forecast is, it pales beside the Board's projected outlook for 2000. At that time, the Board estimates a decline in coal purchases of 38 percent from 1992 figures. For counties in southern Illinois where unemployment is already in double digits, a drop of such dimension in the coal industry would be a crushing blow.

Kim Underwood

While any of these utilities could still opt for a different scenario, the key for Illinois' coal industry will be to continue to champion the role of clean coal technologies in the energy needs of the future. It makes sound economic sense—and even survival—for Illinois' coal interests to align with the cause of technologies that, if demonstrated successfully, can enable utilities and industries to return to burning high-sulfur coal with its higher Btu value and its lower transporation costs to the eastern half of America.

Besides, we don't really have much choice. As the saying goes, adapt or die. Decisions made by utilities to achieve Phase I mandates of the Clean Air Act indicate just how important adaptation to successful clean coal technologies will be for the future of Illinois coal. ✦

Technology Up Close: HSA Hydrated Lime

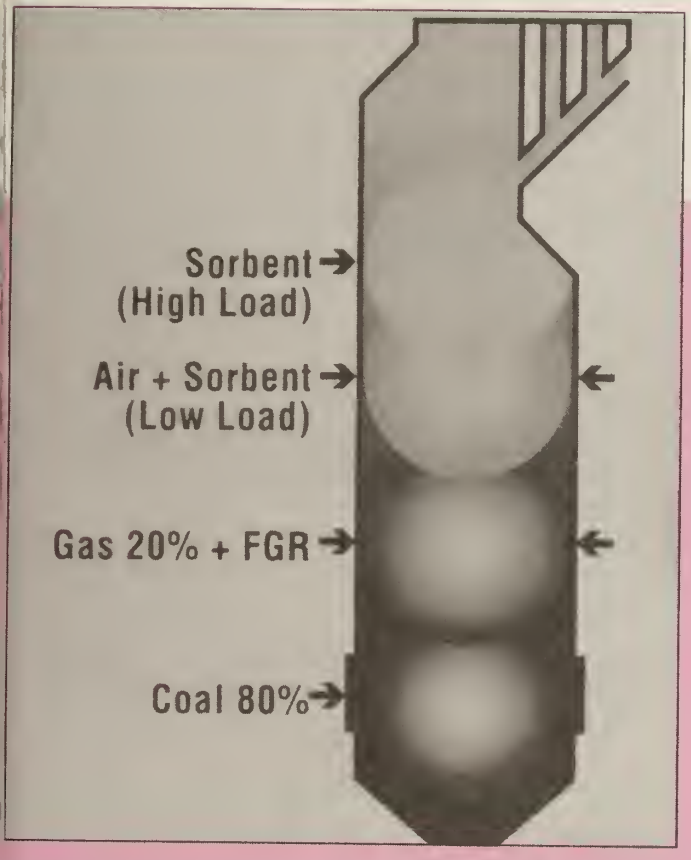
Testing of a promising clean coal technology has been completed at the Illinois Power Company's Hennepin Station in the northern Illinois community of Hennepin.

The technology, known as gas reburning-sorbent injection (GR-SI), was demonstrated and tested with conventional hydrated limes at Hennepin beginning in December 1992. Testing concluded at the site in January 1993. During the final week of testing and demonstration, an experimental high surface area hydrated lime (HSAHL) was injected into the system with encouraging preliminary results.

Long-term tests of the innovative pollution control system at the Hennepin site revealed consistent reductions of nitrogen oxide by 77 percent and sulfur dioxide by 62 percent. Nitrogen oxide and sulfur

The sorbent feeder and weigh hopper shown inside the silo at the Hennepin Power Station.

This diagram of a coal-fired boiler shows the gas reburning-sorbent injection (GR-SSI) clean coal technology being demonstrated at Illinois Power Company's Hennepin Station in northern Illnois. A hydrated lime sorbent is injected to absorb noxious sulfur dioxide. Natural gas is mixed with recirculated flue gas (FGR) to reduce nitrogen oxide emissions. GR-SI can remove 60 percent of nitrogen oxide and 50 percent of sulfur dioxide from emissions.



dioxide are two major air pollutants targeted for reduction by the Clean Air Act amendments of 1990.

During the final week on site at Hennepin, a crew from the Illinois State Geological Survey conducted three days of tests utilizing an experimental high surface area hydrated lime. Under optimal conditions in a laboratory setting, the HSAHL has been tested in various pilot-scale dry sorbent injection processes. Those tests have revealed superior performance over conventional hydrates.

The Survey's HSAHL product has removed up to 90 percent of sulfur dioxide from coal combustion gases in the optimal setting, a 70 percent increase in sulfur dioxide capture over the best performing commercial hydrate tested. Although the Hennepin site was not optimal and not geared to HSAHL, preliminary and unofficial figures appear to be very encouraging.

In addition, the tests were sucessful in that the HSAHL was able to be fed through the existing sorbent feed system without problem. And HSAHL appears to be effective over a relatively broad range of injection temperatures, allowing efficient sulfur capture over a wider range of boiler loads.

The Survey's HSAHL project was initiated under the Illinois Clean Coal Institute's Research Program. Availability of HSAHL can expand the applicability of dry sorbent injection systems and should provide utilities a lower capital cost option for plants that cannot be economically retrofitted with conventional scrubbers.

Testing at Hennepin took place as part of a U.S. Department of Energy (DOE) Round I clean coal demonstration program. The GR-SI technology is a $17 million project by the Illinois Department of Energy and Natural Resource (ENR), DOE, Pittsburg Energy Technology Center and the Gas Research Institute. ✦

"...DOE is "trying to encourage U.S. companies" to participate in the program by "offering assistance for selected community projects."

Poland: New Market for Illinois Coal

Illinois' leadership role in the research, testing and demonstration of clean coal technologies has focused since the 1970s on finding ways to burn Illinois high-sulfur coal more cleanly and efficiently.

Beyond the altruistic goal of cleaner air, the intent also has been to maintain existing markets for Illinois coal in the United States. With two-thirds of coal mined in Illinois currently sold to public utilities and private industries in other states, the Illinois coal industry is in perilous straits. That's because a number of those out-of-state utilities are contemplating a switch to low-sulfur coal to address compliance issues for Phase I requirements of the Clean Air Act.

For many years, Illinois' coal industry has mined about 60 million tons annually from the state's surface and underground mines. Coal mining directly employs approximately 9,000 people in the state, and directly or indirectly contributes approximately $1.5 billion to the Illinois economy, second only to agriculture in southern Illinois.

With some 30 billion recoverable coal reserves, Illinois is looking for ways not only to maintain its market base in the long term, but to expand its horizons as well. Thus, while research scientists at the Illinois Coal Development Park and other facilities around the state investigate new technologies, other people concerned about the Illinois coal industry look for new marketing opportunities.

In recent years, there has been an increasingly greater study of overseas markets, including Europe and Asia.

The Illinois Department of Energy and Natural Resources' Office of Coal Development and Marketing has been studying the prospects of linking clean coal technology activity in Illinois to applications in Poland. A joint effort has been initiated with the U. S. Department of Energy (DOE), Krakow Clean Fossil Fuel and Energy Efficiency Program.

There are two clean coal technology projects underway in Illinois that present a possible connection to the Krakow Program. Both the Tecogen coal/water slurry combustion system being established at the Illinois Coal Development Park in Carterville and the TCS micronized coal technology being demonstrated at the Rochelle Municipal Utilities' power plant in Rochelle could prove applicable to Polish systems.

Through the Krakow Program, DOE is "trying to encourage U.S. companies" to participate in the program by "offering assistance for selected community projects," says Dr. Howard Feibus. Feibus is the director for the DOE Office of Coal Combustion, Coal Preparations and Control Systems and Fossil Energy.

To that end, DOE issued a Program Opportunity Notice in September 1992. Dozens of companies nationwide responded to the solicitation, and about 40 of those companies sent representatives to subsequent meetings in Krakow to learn more about the opportunities. The deadline for submitting an official proposal for the Krakow Clean Fossil Fuel and Energy Efficiency Program is February 19. Final selections of the successful bids, says Dr. Feibus, will be made this summer.

What DOE is looking for, according to Dr. Feibus, are "specific ventures that will have a supplier and a buyer, with the end result being a reduction of pollution in Krakow," a major city in Poland. The Department of Energy has set aside $14.5 million for possible contribution to various selected projects.

Besides offering an applicable technology, a key requirement for any company selected by DOE is that the company must have a Polish partner. Through assistance from the International Business Division of the Illinois Department of Commerce and Community Affairs, TCS Coal Systems, identified an appropriate Polish partner and is continuing with its proposal.

A significant benefit to Illinois' coal industry can be realized from the successful export of clean coal technologies to Poland. Illinois can export some of its clean coal technology expertise in conjunction with its high-sulfur Illinois coal. Since these technologies have been demonstrated on Illinois coal, it is reasonable for the Poles to first learn how to use the Illinois technology with Illinois consultants and coal. ✦

A micrcronization combustion system installed at the Rochelle Municipal Utilities plant in Rochelle, IL. This technology is one of the two being considered by Illinois for exporting to Poland.

"We look to promote the application of new, innovative and proven technologies to supply clean generation of energy utilizing coal."

Midwestern/ Eastern Coal States Coalition

In May 1992, a coalition was formed of coal program leaders from a number of Midwestern and Eastern states. At its first meeting, the coalition was formally organized and mission statements for the group were established. A second meeting took place December 10, 1992. With a new congress and a new president, it will be essential for coal industry leaders to emphasize coal as a reliable fuel source and press for continued development of advanced clean coal technologies. Coalition representative Carol Rowe was recently interviewed by the Illinois Coal Update about the coalition and its goals.

Q. What is the Midwestern/ Eastern Coal States Coalition?

A. The Coalition is made up of coal program leaders from Illinois, Indiana, Ohio, Pennsylvania, Kentucky and West Virginia. Each of these states produces and uses large volumes of coal, has notable state programs or efforts for clean coal technologies and contributes to the improvement of local mining employment and local and state economies. As the Coalition develops and matures, other major producer/user states, such as Missouri, Florida, Georgia and Michigan, might be invited to participate.

Q. What is its purpose?

A. The Coalition hopes to capitalize on common assets and efforts to ensure that Midwestern/ Eastern coals continue to play a significant role in the nation's energy mix.

The Coalition will work to provide sound scientific information on global climate change to legislative decision makers, and to share advancements in clean coal technologies. We look to promote the application of new, innovative and proven technologies to supply clean generation of energy utilizing coal. The Coalition will also work to shape federal policy and future legislative issues. The Coalition was formed to combine the efforts of states with similar economic conditions relative to their coal industries. Thereby, enhancing individual state benefits to those regionally based.

Q. What are your goals?

A. The Coalition has four primary objectives. First, we need to establish communications and work with congressional delegations to develop, evaluate and integrate state and federal initiatives affecting coal producers, utilities and related industries. Second, it is necessary to develop and implement marketing strategies for national and international markets that package coal and advanced clean coal technologies. Third, the Coalition intends to promote advanced clean coal technologies by endorsing and promoting research and development efforts. We will evaluate and identify technologies capable of meeting anticipated environmental standards resulting from global climate change and air quality issues and aggressively market cost-effective ones that meet environmental standards. And finally, the Coalition will coordinate approaches to emission allowance credits to ensure that individual state legislation or policies relating to control or distribution of allowance credits is not counterproductive to the Coalition's objectives or the coal markets in other member states.

Q. How will this be implemented?

A. Each state will work through their governor's Washington offices to assist at the federal level to help form

Carol Rowe, manager of ENR's Coal Development and Marketing Section.

the foundation for the congressional delegation. The Coalition will establish a time frame, assign tasks and will forward reliable information which can be used to help future legislative/congressional activities and legislative initiatives. The mission, goals and objectives will be regularly evaluated to keep members current with compliance issues, new or revised environmental standards and advancements in clean coal technologies.

Q. Are there specific projects for Illinois?

A. Illinois will, in addition to other tasks to be assigned, contribute its experience from managing a Coal Awareness public relations campaign. Illinois has provided information to the National Coal Association to assist them in development of a national public relations campaign.

Q. Besides the mentioned targets, who else does the Coalition try to reach?

A. The importance of coal should be communicated to the general public, educators and children, state government leaders, federal legislators, utilities and coal producers. ✦

Illinois Department of Energy and Natural Resources
Office of Coal Development and Marketing
325 West Adams, Room 300
Springfield, IL 62704-1892

Illinois coal Update

Illinois Department of Energy and Natural Resources

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

- **Kids, Coal and the Environment**
  A coal educational video "starring Illinois kids and dedicated to kids of the future.
- **Technology Up Close**
  Promising clean coal technology completed at the Illinois Power Company's Hennepin Station.
- **Poland: New Market for Illinois Coal**
  ENRs Office of Coal Development and Marketing has been studying the prospects of linking clean coal technology activity in Illinois to applications in Poland.

Printed by Authority of the State of Illinois.

Printed on recycled and recyclable paper.

Illinois Coal Update

ILENR/CD-90/02(93 2)

ENR
Illinois Department of Energy and Natural Resources

Volume 4, Number 2 Summer 1993

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

ICCI Awards Research Grants

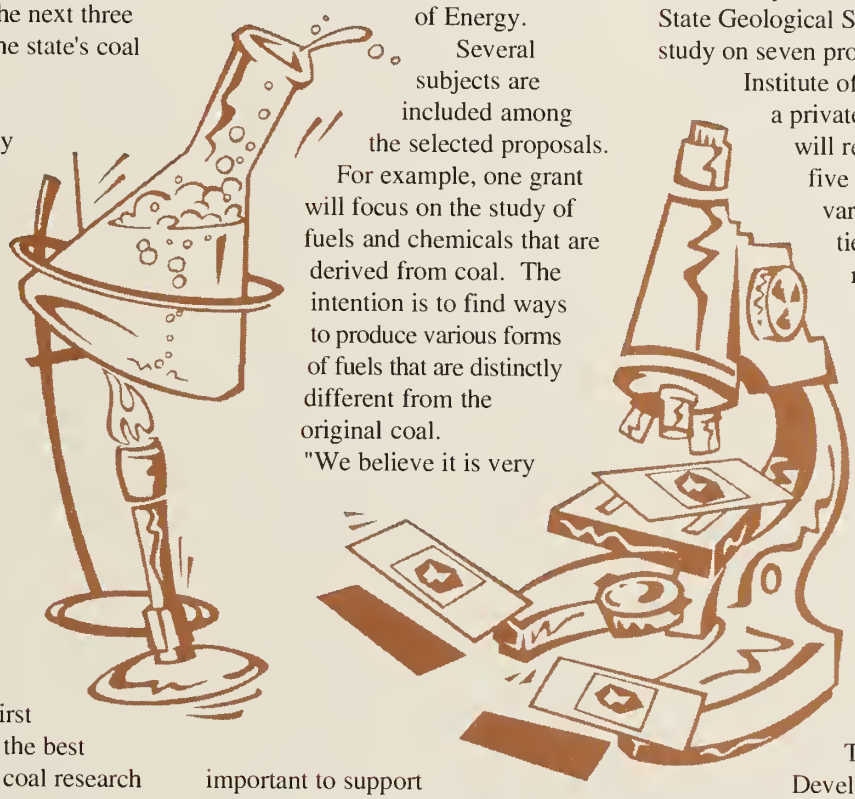
The Illinois Clean Coal Institute (ICCI) has an urgent mission. "We must find ways to greatly decrease sulfur dioxide emissions when Illinois high-sulfur coal is burned, in order to fully comply with the Clean Air Act amendments of 1990," explains Richard Shockley, ICCI director. "This focused urgency exists because we need to solve the problem in the next three to five years to keep the state's coal industry alive."

To help reach this ambitious and crucially important goal, ICCI has awarded 33 research grants totaling more than $3.1 million to 13 different institutions. In each case, ICCI fully believes that these projects show promising ability to accomplish key objectives.

Shockley says the Institute has three primary criteria which it considers when reviewing research proposals. "We look first for the ability to make the best use of existing Illinois coal research facilities," he points out. "Second, we want to generate an interest in Illinois Basin coal research among potential researchers and industries. And third, we wish to minimize duplicative research."

The 33 grants were selected from 89 proposals which had been submitted. The Institute encourages interaction between universities, research centers and industries, with preferential consideration given to those proposals that show a potential for commercialization of new technologies by the end of the decade.

Funding for the grants is primarily provided by Illinois' Department of Energy and Natural Resources (ENR) through the Illinois Coal Development Board. In addition, through its efforts the state helped attract an additional $1 million in funding from the U.S. Department of Energy.



Several subjects are included among the selected proposals. For example, one grant will focus on the study of fuels and chemicals that are derived from coal. The intention is to find ways to produce various forms of fuels that are distinctly different from the original coal.

"We believe it is very important to support and promote promising research for clean coal technology and alternative coal use," says John S. Moore, ENR director. "These studies may well mark the difference between growth, maintenance or survival for Illinois' high-sulfur coal industry. It is our goal to protect the nearly 9,000 coal mining jobs in the state, as well as thousands of related jobs that depend upon a vibrant coal industry.

ICCI judges also look for studies that promote advanced combustion technologies, gas cleanup, coal cleaning and coal characterization. Related studies such as economic evaluation, market analysis, materials research, waste management and global climate control were also requested.

Southern Illinois University at Carbondale has received 10 grants, most of any institution. The Illinois State Geological Survey will pursue study on seven projects and the Institute of Gas Technology, a private research group, will receive funding for five proposals. A variety of universities, government research centers and corporate research labs received the remaining grants.

The Illinois Clean Coal Institute, located in Carterville, Illinois, is dedicated to energy research for a cleaner environment. The Illinois Coal Development Board oversees the Institute, which is a branch of ENR's Office of Coal Development and Marketing. Abstracts of individual projects are available upon request at ICCI. Call 618/985-3500 for more information. ✦

". . . Illinois leads the pack in the development of clean coal technologies."

Setting Coal's Future Standard

By Kim Underwood, Director, Office of Coal Development and Marketing Illinois Department of Energy and Natural Resources

The political wrangling earlier this year over a proposed energy tax once again brought discussions of coal use to the forefront. Diatribes about the economic and environmental impact of fossil fuels were bantered back and forth among both press and politicians, and "King Coal" was readily portrayed as a villainous monarch.

It is crucial that we always stay one step ahead of our critics in order to control the destiny of our industry. This cannot be done merely through lobbying and publicity. We must be leaders in developing economically viable and applicable clean coal technologies and alternative coal-use techniques in order to keep our Illinois coal industry alive and profitable.

The status quo changed dramatically for Illinois coal producers and employees alike in 1990 when the Clean Air Act amendments were passed. We were handed a momentous task that most industries have never faced. Basically, our mandate was to reinvent the way we had done business for several generations, and do so quickly.

Kim Underwood

By the year 2000 we were told to reduce sulfur dioxide emissions by 10 million tons from 1980 levels. Likewise, nitrogen oxide emissions would need to undergo substantial reductions.

We have faced that challenge head-on. As a result, Illinois leads the pack in the development of clean coal technologies. Through the Illinois Coal Development Board, the state's Department of Energy and Natural Resources (ENR) and ENR's Office of Coal Development and Marketing, Illinois has attracted several hundred thousands of dollars from federal, state and private sources over the past 15 years in numerous cost-sharing programs.

As a result, our laboratories and offices are occupied by many of the best researchers and scientists in the world. Further, these individuals are not hunkered down in a defensive mode to "protect" coal for coal's sake. Rather, they are in the forefront of efforts to unlock the true energy potential of high-sulfur coal that can be viable both economically and environmentally.

What we must keep in mind is that this is not a one-shot challenge with a quick fix. Successful business people must be visionaries. It's tempting to be shortsighted in this time of change and urgency in our industry. But in order to preserve viability for our abundant natural resource—as well as 9,000 coal mining jobs and thousands of ancillary jobs dependent upon the coal industry—we are aggressively preparing for the future.

We are keenly aware that one of our most important tasks is to anticipate future barriers and problems. One method for dealing with such concerns is education. We believe it is extremely important to inform the public at large about the value coal brings to the world.

To that end, we are working directly with the school children of our state to make them aware of exactly what coal brings to their everyday lives. Helping them understand that 57 percent of our nation's electricity is derived from coal, and that electricity drives so much of our modern society. Through such excellent vehicles as the "Words and Pictures About Illinois Coal" calendar contest and the state's Coal Awareness Week, we have the chance to provide direct involvement for students with the whole coal "concept." The first-hand knowledge they acquire gives them new insight into a frequently misunderstood "realm" of science.

We know that the problems posed by the Clean Air Act amendments may be followed by even more serious challenges. The controversial topic of global climate change and the related apprehension about carbon dioxide emissions, as well as overall concern for the environment, paint a gloomy view of the world and cast the use of coal as an antagonistic and destructive force.

These are issues that require pro-active answers and a vigilant response. The best response to any such concerns will be the research, testing and development of efficient clean coal technologies. The Illinois Clean Coal Institute (ICCI) just awarded more than $3 million in grant money to a variety of institutions for research.

We constantly strive to find new directions to take our industry. Exciting research to find alternative non-energy uses for coal and to create markets for coal by-products is projected to lead the coal industry down an entirely new and profitable path.

Obviously, we are not sitting idly by. In our industry, there is strength in diversity. We strive to stay ahead of current trends so that we can continue to set the standard in clean coal technology research, development and demonstration to answer the continuous challenges to our industry. ✦

1993 calendar of Coal Events

August 3-5
Illinois Coal Development Board
Eleventh Annual Contracts
Technical Conference
Urbana, IL

August 4
Illinois Coal Development
Board Meeting
Urbana, IL

August 12-22
Illinois State Fair
Coal Display - Illinois Building
Springfield, IL

August 28- September 6
DuQuoin State Fair
Coal Display
DuQuoin, IL

September 23 & 24
Illinois Mining Institute
Annual Meeting
Coal Education Display
Collinsville, IL

October 17-23
Coal Awareness Week

- **October 19**
  Educational Activities
  Illinois Coal Development Park
  Carterville, IL

- **October 21**
  Educational Activities
  Illinois State Fairgrounds
  Expo Bldg.
  Springfield, IL

October 19
Illinois Coal Development
Board Meeting
Carterville, IL

December 14
Illinois Coal Development
Board Meeting
Springfield, IL

Environmental Fingerprints

For the first time in contest history, winners and participants of the fifth annual "Words and Pictures About Illinois Coal" art and essay contest came to Springfield, Illinois from every corner of the state — from Wheaton to Carbondale and from Belleville to LaHarpe — to participate in the award ceremony recognizing the 25 contest winners. The festivities were also seen by numerous Springfield-area residents that evening on the WICS-TV late news.

More than 700 students from fifth and sixth grade classes in Illinois schools participated in the contest, co-sponsored and judged by the Illinois Department of Energy and Natural Resources (ENR) and Southern Illinois University at Carbondale. John S. Moore, director of ENR noted, "The artwork and essays submitted by this year's fifth and sixth grade students is a fine example of the talent and intelligence found in today's children."

Taylor Pensoneau, vice president of the Illinois Coal Association presented each of the 25 winners with a $50 United States Savings Bond and certificate signed by Governor Jim Edgar. In addition, the winners and their teachers will receive free copies of the popular 1994 "Illinois Coal Calendar," featuring the award-winning artwork and essays.

The students' winning artwork and essays will be distributed nationwide in the 1994 calendar. Each month, the colorful artwork and creative essays in the calendar will illustrate what the students have learned about coal, energy and the environment.

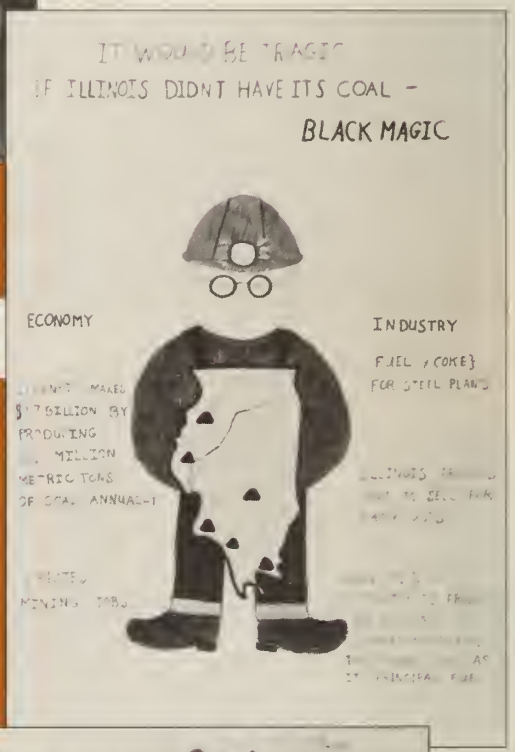
". . . the contest is just one example of how the state of Illinois is dedicated to on-going environmental education."

(L - R) Carol Rowe of ENR, Kendra Worley, Joshua Marc Aaron, Broc T. Finch, Andrew Wilson, Justin Hand, Taylor Pensoneau of the Illinois Coal Association, Jillian M. Loebach, Abbie Coley, Blair Vickroy, Tammy Rothert, Lisa Sandstrom and Andrea Miologos.

Created to help children learn more about the Earth's precious natural resources, the contest is just one example of how the state of Illinois is dedicated to on-going environmental education. Through this fun, educational program, students learn that Illinois' most abundant resource—coal—can be a safe and environmentally-friendly energy source for the future.

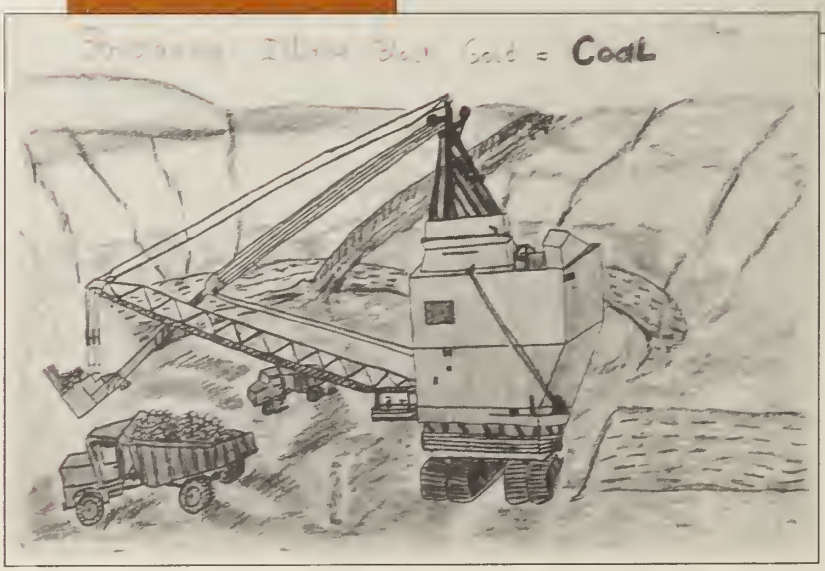
All winning students and their teachers will be invited to participate in the Coal Awareness Week festivities in October at the Illinois Coal Development Park in Carterville, Illinois or at the Expo Building, State Fairgrounds, Springfield, Illinois.

The 1994 calendars will be available in the fall and are free while supplies last. To order a 1994 "Illinois Coal Calendar," write the Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing, 325 West Adams, Room 300, Springfield, Illinois 62704-1892, or call 217/782-6370. Illinois residents can call ENR's Information Clearinghouse toll-free at 1-800-252-8955. TDD customers can call ENR at 217/785-0211, or the Illinois Relay Center at 1-800-526-0844. ✦



Shown are two winners of the fifth annual "Words and Pictures About Illinois Coal" art and essay contest. The miner, at right, was drawn by Jillian M. Loebach of Hennepin.

The dragline scene, below, was drawn by Roy Dale Bradford of Marietta.



"This technology is very important to Illinois because this process helps make our high-sulfur coal more efficient and marketable than low-sulfur coal."

Dr. John Lytle Discusses Coal ISGS Research

Illinois has developed a positive reputation and track record in clean coal research due to innovative developments of coal-efficient technology. This progressive attitude attracts many top scientists to the state, including Dr. John Lytle of the Illinois State Geological Survey (ISGS). Currently serving as Senior Chemical Engineer and Head of the Minerals Engineering Section of ISGS, we asked him about his activities and the current state of affairs in clean coal research.

Q. You work with the Minerals Engineering Section of the ISGS. What is your section's function and what are its goals?

A. Our function basically is to solve problems related to mineral engineering in Illinois. Our immediate goal is to develop new uses for coal and continue the viability of the old functions, especially in boilers and utility use. We are practical in our approach and emphasize the economical use of Illinois' natural resources. The focus is on the real world and the real cost. Our desire is to develop technology from the experimental stage to the commercially realistic stage.

Q. What sort of clean coal research has your department been involved with lately?

A. One of the most significant developments in this area is a new gasification technology called Integrated Gasification Combined Cycle, or IGCC. Some leading chemical companies have developed specialized equipment that recovers the sulfur in coal to use as a byproduct. This technology is very important to Illinois because this process helps make our high-sulfur coal more efficient and marketable than low-sulfur coal. We have been involved in research to find out how to make ideal feedstocks from Illinois coal for use in the IGCC process to promote new and increased uses of our coal.

Q. How does it work and what did you find?

A. The IGCC process uses slurry fed coal, which is a combination of coal and water. When using Illinois coal, the slurry mixture can be approximately 65 to 70 percent coal and 30 to 35 percent water, whereas western coals require that the mixture contain only 50 to 55 percent coal. Otherwise, the slurry won't flow properly. Because Illinois coal has more Btu's per pound than western coal, our coal has a higher efficiency and power output. Illinois coal has a 42 percent efficiency rating versus 39 percent for western coal using the same size equipment. In terms of electricity output, an IGCC plant using Illinois coal would produce 240 to 260 megawatts, whereas the same plant using western coal would produce only 180 to 200 megawatts.

This all translates into lower installation costs, greater efficiency and a cleaner environment. For example, we learned that Illinois coal works well in a gasifier and doesn't clog injection nozzles. With these findings we were able to arrange meetings among five Illinois coal companies, two utilities and the Illinois Department of Energy and Natural Resources. These meetings resulted in a $591 million power plant now in construction that will use Illinois Basin Coal.

Dr. John Lytle, Senior Chemical Engineer and head of the Minerals Engineering Section of ISGS.

Q. You've been involved with an innovative CCT technology using Illinois lime. Can you tell us about this?

A. We developed a sulfur sorbent called high-surface-area hydrated lime (HSAHL) and the process to make it. The lime is injected into flue gas or directly into a boiler through nozzles separate from the coal feeder. We conducted a 45-ton test at Illinois Power's plant in Hennepin and found that the ISGS' sorbent captured 70 percent of the sulfur dioxide from stack gas. This is significantly more than the 50 to 55 percent captured by the commercially available sorbent.

Q. One of your objectives is to create new markets and products using Illinois coal. What development do you have in this area?

A. We want to create value-added products from coal the way the petrochemical industry has from petroleum. One such product is carbon molecular sieves, which separate the gases oxygen and nitrogen from air. We can isolate 95 to 99 percent pure nitrogen by passing air through the sieve. ✦

Illinois Department of Energy and Natural Resources
Office of Coal Development and Marketing
325 West Adams, Room 300
Springfield, IL 62704-1892

BULK RATE
U.S. POSTAGE
PAID
Springfield, IL 62704
Permit No. 128

Illinois coal Update

Illinois Department of Energy and Natural Resources

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

- **ICCI Awards Research Grants**
  The ICCI awarded 33 research grants totaling more than $3.1 million to 13 different institutions.

- **Setting Coal's Future Standard**
  Leaders in developing economically viable and applicable clean coal technologies and alternative coal-use techniques in order to keep our Illinois coal industry alive and profitable.

- **Q & A**
  Dr. John Lytle of the Illinois State Geological Survey discusses the problems related to mineral engineering in Illinois.

Printed by Authority of the State of Illinois.

Printed on recycled and recyclable paper.

Illinois Coal Update

ILENR/CD-90/02(94-1)

ENR Illinois Department of Energy and Natural Resources

Volume 5, Number 1 1994

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

State Expands Coal Awareness '93 to Two Sites

The fifth annual Coal Awareness Week in Illinois, held October 17-23, was a resounding success for more than 1,300 schoolchildren who attended. The theme "Power from Coal" was highlighted in the many displays, exhibits and activities used to educate the students.

Coal Awareness Week is the focal point of the Illinois Department of Energy and Natural Resources' (ENR) Office of Coal Development and Marketing's comprehensive energy education program for children. The event is geared to 5th and 6th graders and features displays and demonstrations that teach the history of mining, the importance of coal, and the strides that Illinois has taken in clean coal technology research.

To give students from central and northern Illinois an expanded coal education, ENR decided to bring Coal Awareness Week to Springfield for the first time. Previously celebrated in Carterville at the Illinois Coal Development Park, the event was expanded a second day held in Springfield at the State Fairgrounds.

The Carterville event took place October 19 with more than 350 children braving the rain to attend the special ceremonies and activities, which included honoring the winners of the annual coal calendar contest, "Words and Pictures About Illinois Coal."

Wayne Frankie of the Illinois State Geological Survey - Coal, Oil and Gas Section listens to children' questions about coal during Coal Awareness Day in Carterville.

The Illinois State Fairgrounds set the stage as nearly 1,000 schoolchildren gathered to expand their knowledge of coal.

A magician entertained the children at both events and served as moderator using his "magic" to help explain how electricity works. Several of the displays at Coal Awareness Week illustrated the importance of coal in relation to electricity. ENR showed a video and slide show explaining how coal is mined and how it provides electricity for daily use.

A detailed replica of an actual coal mine was of great interest to hundreds of fifth and sixth graders who attended Coal Awareness Day in Springfield.

"The future of the coal industry will someday be in the hands of these children. Understanding coal's significance to our lives, the environment and to the history of Illinois is extremely important," said Kim Underwood, director of the ENR Office of Coal Development and Marketing. "Children show an increasing interest in coal and energy, and their impact on the environment. We are proud that Illinois leads the nation in education and coal research."

"The micronized coal process is expected to reduce sulfur dioxide by up to 50 percent and nitrogen oxide air pollution emissions by up to 20 percent..."

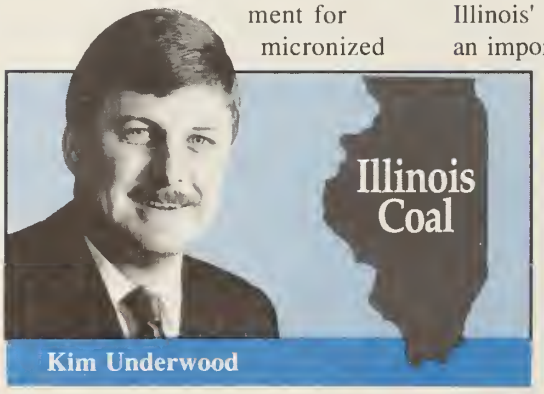
Poland To Use Illinois CCT's

By Kim Underwood, Director, Office of Coal Development and Marketing Illinois Department of Energy and Natural Resources

Operators of two clean coal technology (CCTs) projects currently being demonstrated in Illinois have been selected by the U.S. Department of Energy to help Poland improve its air quality and the efficiency of its coal-burning operations.

Tecogen, Inc. of Waltham, Massachusetts will work with Control Techtronics, Catholic University and Penn State University as well as with three Polish firms (Naftokrak, Sefako and Kowent) to design and install an integrated system of advanced U.S. technology for combustion, emissions reduction and process control equipment in a district boiler house. The team plans to market the system throughout Poland and Eastern Europe.

Also, Tas Coal Systems, Inc. of Washington, DC will be involved in a project with Amerex, Inc., the Polish company Opam and the Polish Military Unit No. 1616. Together, they will install equipment for micronized coal systems on boilers at the Krakow airport.



Kim Underwood

The U.S. Department of Energy is providing $14.5 million as part of a joint U.S./Polish effort to bring clean coal technologies to Poland. Total cost for the projects is estimated to be $31 million. Polish team members will assist in commercializing the demonstrated technologies in Poland, where approximately 80 percent of electricity is derived from coal.

Both Tecogen and TCS currently are demonstrating clean coal technologies at sites in Illinois. In March 1993, the city of Rochelle's Municipal Utilities was retrofitted for the TCS micronized coal technology to test and demonstrate the co-micronizing of coal and limestone.

The $18 million CCT project at Rochelle is partially funded by a $3.6 million grant from the Illinois Department of Energy and Natural Resources, with additional funding provided by Rochelle Municipal Utilities.

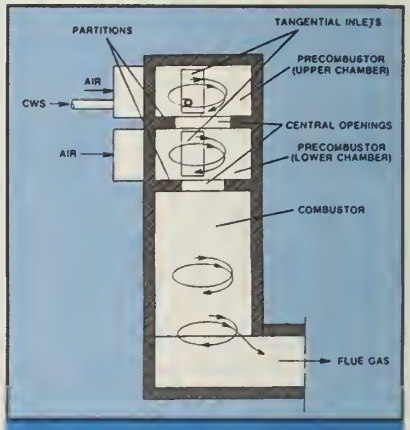
The micronized coal process is expected to reduce sulfur dioxide by up to 50 percent and nitrogen oxide air pollution emissions by up to 20 percent while substantially lowering operating costs.

This process will enable utilities to utilize the higher Btu content of high-sulfur coal. If successful, testing can be duplicated in Poland. Illinois' high-sulfur coal could find an important new European market.

Micronized coal has been successfully fired in gas/oil boilers, in addition to conventional coal-fired units. That flexibility makes micronized coal much more economical.

Due to extremely low carbon content, coal ash that is produced as a byproduct has value as a cement feedstock and is superior to conventional pulverized coal fly-ash.

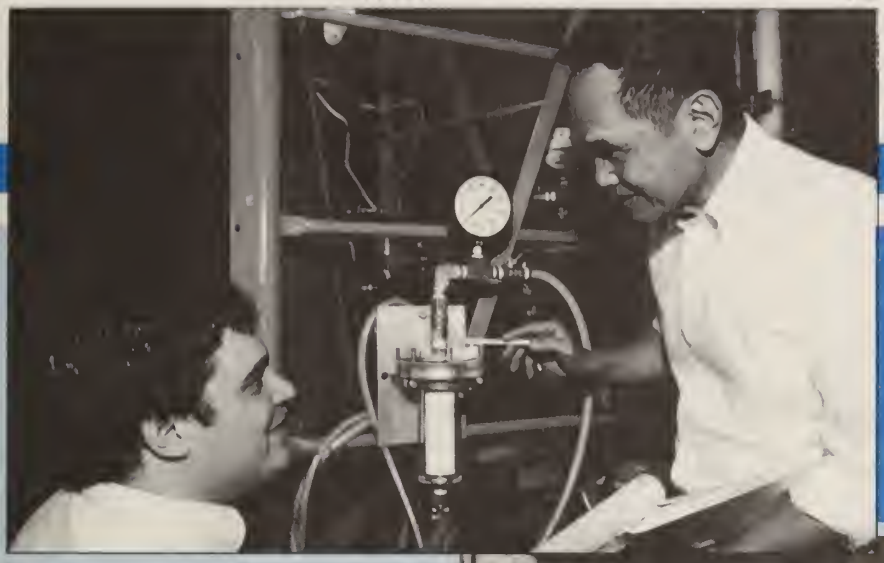
Tecogen's coal/water slurry system is an innovative combustion technology for generating heat for industrial use, capable of eliminating 90 to 95 percent of sulfur dioxide gas that is produced from the use of high-sulfur coal.



A rendering of the Tecogen combustor. Its distinctive design swirls a coal/water mixture, known as a slurry. (CWS, in diagram) Swirling keeps the slurry in suspension long enough for complete combustion and results in minimized ash waste and pollution.

Presently, most industrial spaces are heated by fuel oil or natural gas. However, if successful, the technology could cost-effectively heat shopping malls, manufacturing facilities and other large industrial spaces.

The Polish government has required that Poland cut sulfur dioxide emissions by 50 percent by the year 1998. The Department of Energy is hoping to help Poland achieve that goal through the demonstration of the selected CCTs. If successful, these clean coal technologies could greatly benefit the high-sulfur coal industry, both in Poland and in the United States.



(Left) Rick Honaker and Ken Ho, researchers at the Illinois Coal Development Park in Carterville, discuss their findings on column flotation methods to be used for clean coal technology.

(Below) Ken Ho displays the differences in consistency of clean coal slurry on the left and coal tailings on the right.

Technology Up Close: Column Flotation

Currently, several clean coal technologies are being tested in attempts to remove large amounts of sulfur dioxide and nitrogen oxide from coal.

One of these technologies, froth flotation, has proven to be the most efficient method to clean fine coal to date, according to Rick Honaker, a scientist at Southern Illinois University-Carbondale (SIU-C).

Conventional froth flotation works by injecting a coal/water mixture known as a slurry into a box-shaped container of water, and mechanically creating bubbles in the mixture. "Undesirable" elements of coal, such as clays and pyrites, which when burned produce sulfur dioxide, have hydrophilic characteristics, meaning they "cling" to water instead of air. This effect causes such elements to sink to the bottom of the container.

Coal reacts in an opposite fashion. It is hydrophobic, meaning that it clings to the air in bubbles. A froth is created which rises to the top of the mixture and can in effect be skimmed off, leaving coal with a highly reduced sulfur content.

However, there are certain limitations with this process. That is why researchers at the Illinois Coal Development Park in Carterville are evaluating alternative methods of froth flotation in order to find an even more efficient and economical method for fine coal desulfurization.

Ken Ho of the Illinois Clean Coal Institute (ICCI) is project manager overseeing this research, with Rick Honaker and Bradley Paul of SIU-C as co-principal investigators. Their research, funded by ICCI and the U.S. Department of Energy, centers on column flotation technology.

Problems with conventional froth flotation have to do with the depth of froth that is created. Because of the container's box shape, there is not enough hard surface for froth to cling to; therefore, it creates a shallow layer. Because the froth layer is shallow, it is wet and contains more undesirable elements that cling to water.

In order to rectify this problem, several companies have created column flotation devices. With more surface for froth to cling to, this cylinder shape creates a deeper froth level, allowing more time for drainage. Less water in the froth means less undesirables in the coal concentrate. This allows recovery of greater amounts of "clean" coal from the mixture.

Ho says there are currently six column designs on the market. Each type has its advantages and disadvantages. But they have never been objectively compared to each other, using Illinois Basin coals. The goal

"It is imperative that we increase our financial commitment to coal technology applications and research."

of researchers at the Park is to test each design under exact conditions so that coal companies can compare results and draw their own conclusions concerning which type of column is best for cleaning coal.

"There are a variety of factors to be considered when analyzing this important clean coal technology," says Ho. "Some scientists believe that bubble size is an important factor, while others don't think bubble size matters. Other considerations measured by scientists include ash and pyrite regulation, Btu recovery, capacity, reagent consumption, convenience and space occupied."

Honaker explains that the columns are made and marketed around the world. Four were developed in America: the Microcel, the Turboair, the Packed column and the Flotaire. The remaining columns are the Australian Jameson cell, and the Canadian column.

"What are most important to document are the separation performance and the capacity for each column," says Honaker. "We think the latter is where we're going to see the biggest difference. Capacity will depend on the quantity and size of the bubbles."

ICCI director Dick Shockley says that this work is significant because, "all the technologies are commercially available, and when the most effective type is determined it can be used immediately to reduce sulfur and ash content from Illinois coal."

In addition, Shockley notes that flotation columns "can effectively treat coal fines containing a high clay content while maintaining high combustible recovery. These are values which will benefit several coal preparation plants operating in the Illinois Coal Basin."

Governor Edgar Approves '94 Coal Funding

The Illinois coal industry has received a boost from Governor Jim Edgar, who this summer signed two pieces of legislation designed to increase funding for projects utilizing and promoting Illinois coal.

House Bill 775 doubled the amount of state funding that can be made available for research and development projects promoting the use of the state's high-sulfur natural resource. Senate Bill 406 is a $35 million general obligation bond authorization to be used for coal demonstration projects.

The House bill, signed into law August 20, 1993, increased the amount of money that can be transferred from the general revenue fund to the Coal Technology Development Assistance (CTDA) fund to $10 million. The increase funding will be phased in over three years.

"It is imperative that we increase our financial commitment to coal technology applications and research," said Governor Edgar. "Given the requirements of the Clean Air Act and the existing need to install costly scrubbers to burn high-sulfur Illinois coal, we must provide additional funds to find less costly alternatives and keep the Illinois coal industry prosperous."

Governor Edgar told the citizens of Illinois that "this legislation represents the continuing commitment of my administration to maintain and expand markets for one of Illinois' most abundant natural resources and to help restore economic vitality to the Illinois coal industry."

"Through this program, the Department of Energy and Natural Resources will be able to better work with private industry and with our universities to further the economically competitive use of Illinois coal through clean coal technologies," Edgar added.

Edgar was quoted as saying that this legislation was significant because, "the Department of Energy and Natural Resources will be able to fund additional clean coal technology projects, expand coal markets and work to further the economically competitive use of Illinois coal."

"These additional funds will leverage other private and federal funds, helping to guarantee that Illinois coal and agricultural products remain a competitive fuel source in the future," he continued.

Kim Underwood, director of ENR's Office of Coal Development and Marketing, said that his department was pleased with the increases that further indicate Governor Edgar's commitment to keep the coal industry viable and competitive.

Coal Calendar of Events for 1994

Coal Development Board Meetings

May 25	Springfield
October 18	Carterville
August 3	Champaign
December 6	Springfield

Coal Awareness Week

October 16-22

Education Days

October 18	Carterville
October 20	Springfield

"...to avoid if possible, economic disruptions and job losses in bringing about emission reductions..."

Illinois Group Addresses Global Climate Change

It has been projected that carbon dioxide concentrations in the atmosphere may double during the 21st century. Concerns about CO_2's effect on the environment and any legislation that will stem from this concern prompted the Illinois legislature to create the state's Global Climate Change Task Force. We spoke to Taylor Pensoneau, a member of the task force and Vice President of the Illinois Coal Association, about the goals and concerns of the group.

Q: Why was the Global Climate Change Task Force created?

A: The Illinois Task Force on Global Climate Change was created by the Illinois General Assembly to monitor national policy, and to make recommendations for state policies and programs in regard to climate change issues. The task force, appointed by Governor Jim Edgar, includes Illinois legislators, directors of state agencies and representatives of the business, environmental, academic and scientific worlds. Overall, the task force consists of 20 members including myself and Jack Moore, the director of the Department of Energy and Natural Resources who is task force chairman.

Q: What are your goals?

A: Our mandate is to formulate state policies and programs on world climate issues so that we can address the subject both in an environmentally responsible manner and in a fashion that doesn't cripple the economy of Illinois. Many interests in Illinois, such as coal, have a potentially major stake in this matter. Sound and balanced reasoning must be applied both in Illinois and by Illinois to avoid any "ramrod" responses to global climate issues that would be unfair to our state.

Q: What have you accomplished to date?

A: In August 1993, the task force sent to the White house and the Illinois congressional delegation a set of policy recommendations for consideration by federal officials and others. Those recommendations seek to stabilize greenhouse gas emissions by the year 2000 at 1990 levels, a goal of President Clinton. In addition, we have directed state research on other global climate issues and have sought to determine possible impacts on different segments of the state that could result if certain actions were taken on global climate issues.

Q: In what research is the task force involved?

A: Well, for example, the task force has fostered research on the economic effects in Illinois that may result from any global climate change, such as on crop yields and other aspects of agriculture, the need for electricity and other energy demands, or river levels. Much of this research is spearheaded by Stan Changnon, the respected leader for many years of the Illinois State Water Survey. Of course, the Survey is Illinois' best repository of research and information on global climate change.

Taylor Pensoneau, Vice President of the Illinois Coal Association and member of the Illinois Global Climate Change Task Force.

Q: How does the Illinois task force stand regarding President Clinton's greenhouse gas policy?

A: The task force welcomed the concentration in Clinton's plan on voluntary actions instead of mandatory controls in trying to reduce or stabilize greenhouse emissions. We also want the federal government to support more scientific research on global climate patterns, to avoid if possible, economic disruptions and job losses in bringing about emission reductions and to cooperate or act in concert with foreign countries in reducing the rate of global greenhouse gas emissions. We do not believe that the United States can act unilaterally on this matter.

Illinois Department of Energy and Natural Resources
Office of Coal Development and Marketing
325 West Adams, Room 300
Springfield, IL 62704-1892

Illinois coal Update

Illinois Department of Energy and Natural Resources
Office of Coal Development and Marketing
John S. Moore, Director; Jim Edgar, Governor

- **Governor Edgar Approves '94 Coal Funding**
  The Illinois coal industry was boosted by two pieces of legislation designed to increase funding for projects utilizing and promoting Illinois coal.

- **Poland to Use Illinois CCT's**
  Two CCT's demonstrated in Illinois are selected to help Poland improve its air quality and efficiency of its coal-burning operations.

- **Illinois Group Addresses Global Climate Change**
  Illinois legislature creates the state's Global Climate Change Task Force to monitor national policy, and make recommendations for state policies regarding climate change issues.

Printed by Authority of the State of Illinois.
Printed on recycled and recyclable paper.

Illinois Coal Update

ILENR/CD-90/02(94-2)

ENR Illinois Department of Energy and Natural Resources

Volume 5, Number 2 1994

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

New Ground Broken for Project at the ICDP

Literally years of anticipation were rewarded in late April when ground was broken for a potentially significant coal technology project at the Illinois Coal Development Park (ICDP) in Carterville.

A three-year project for the demonstration of a process for mild gasification of coal known as MILDGAS was officially dedicated April 23 on a dazzlingly clear and beautiful spring day. Dozens of dignitaries from Illinois and throughout the country were on hand to celebrate the start of construction for the MILDGAS project.

The event marked the culmination of more than three years of preparation since the project was first approved in March 1991. Funding for the $18.4 million demonstration includes $14.7 million from the U.S. Department of Energy, $3 million from the State of Illinois through the Department of Energy and Natural Resources, and in-kind or cash contributions totaling $700,000 from project participants such as Southern Illinois University at Carbondale (SIUC), General Motors Corp. and Kerr-McGee Coal Corp.

"This project has been much anticipated within the Illinois coal industry," said Richard Shockley, director of the Illinois Clean Coal Institute, which is based at the ICDP. "We believe that this technology will successfully demonstrate how Illinois coal, which already possesses superior heating quality, can also be cleanly used to fill a variety of new market applications in compliance with the federal Clean Air Act."

The process is designed to 'refine' raw coal and to turn it into marketable, high-value solid and liquid products in addition to a product gas which is recycled to provide heat. Ultimately, it is hoped that the MILDGAS process will convert Illinois coal into environmentally sound and economically efficient products.

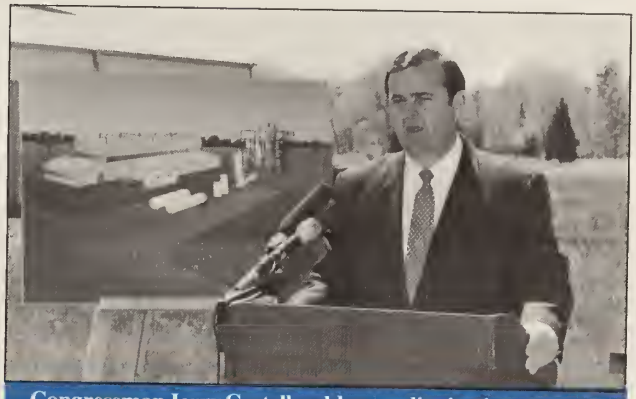
John Mead, director of SIUC's Coal Research Center, presided over the day's activities. Speakers at the ceremony included Congressman Jerry Costello, Jo Poshard, wife of Congressman Glenn Poshard; Kittie Connor, a representative of U.S. Senator Carol Moseley Braun; and Keith Westhusing, an official with the U.S. Departmentof Energy.

Other dedication remarks were made by SIUC president Dr. John Guyon; Institute of Gas Technology (IGT) president Dr. Bernard Lee; Kerr-McGee Coal president Robert C. Scharp; Bob Casteel, spokesperson for John S. Moore, director of the Illinois Department of Energy and Natural Resources (ENR); and Kim Underwood, director of ENR's Office of Coal Development and Marketing.

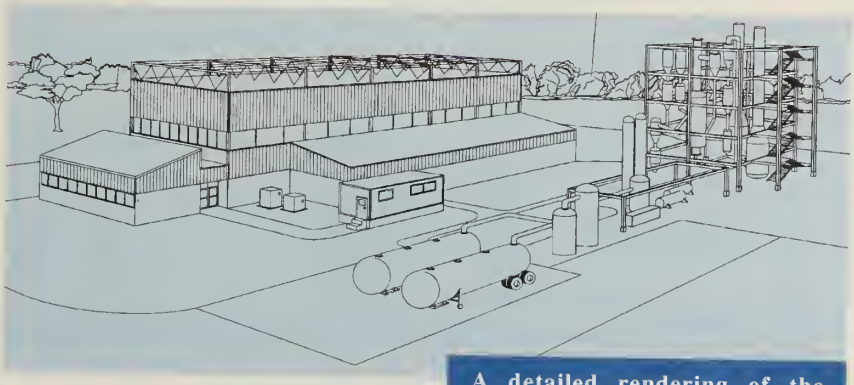
Also in attendance were State Senator Ralph Dunn, State Senator Jim Rea, State Representative Gerald Hawkins and State Representative David Phelps.

A team headed by Kerr-McGee Coal will work on the project, which will involve the design, con-

see MILDGAS on page 2



Congressman Jerry Costello addresses dignitaries and other guests who gathered at the Illinois Coal Development Park on Saturday, April 23 for the groundbreaking of the MILDGAS demonstration project.



A detailed rendering of the MILDGAS demonstration project.

"...the potential clean coal technology market for new facilities and retrofit installations in foreign countries could amount to between $570 billion and $870 billion by the year 2010..."

- Illinois Coal Development Board

MILDGAS

struction and operation of a process development unit (PDU) that will process 24 tons of coal per day. Team members include IGT, SIUC and the Bechtel Corp. The PDU is scheduled to begin test operations in June 1995, with testing to continue through 1996.

"This is a win-win project for all of us," said Costello. "This project can help keep our coal miners on the job and find new ways to use the coal we have in southern Illinois."

The MILDGAS process was developed by IGT, a Chicago-based, not-for-profit energy and environmental research and development organization. MILDGAS is a technique in which coal is heated in the absence of oxygen to produce liquids and a solid char. At the heart of MILDGAS is a new technology which allows continuous processing of the coal.

Solid char can be converted into an environmentally sound "form coke," which can be used instead of conventional coke in steel blast furnaces and foundries. "Mild gasification is much cleaner than the standard process for making coke," said Lee. "And it offers a good solution to the steel industry for meeting the requirements of the Clean Air Act."

Underwood underscored the importance of the MILDGAS effort. "This type of research and development provides a unique opportunity," he said. "It is crucial that we develop alternative markets for Illinois coal. Options other than utility generation must be explored." ✦

'94 Coal Board Report Looks For Market Solutions

Faced with dire predictions of lost mining jobs and a sharp decrease in coal production, the Illinois Coal Development Board (ICDB) has recommended several strategies designed to keep Illinois' coal industry viable in the future.

Those strategies are contained in the Board's 1994 "Outlook for the Illinois Coal Industry," which is published by the Illinois Department of Energy and Natural Resources (ENR). The report was prepared for Governor Jim Edgar and members of the 88th General Assembly and presented by John S. Moore, ENR director and ICDB chairman.

The ICDB is mandated by state law to keep the legislature apprised annually of activities affecting Illinois' coal industry.

The report is primarily written by Gary Philo, Energy Resource Specialist for ENR's Office of Coal Development and Marketing.

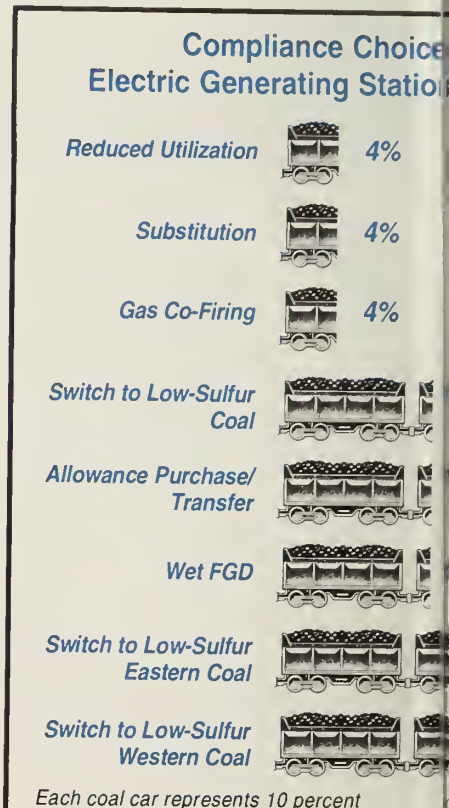
With the Phase I deadline for the Clean Air Act amendments of 1990 looming January 1, 1995, more than 100 public utility power plants are making decisions on how to lower sulfur dioxide emissions by that time. As a result, sales of high-sulfur Illinois coal are projected to decline significantly from the 60-million ton level of the past several years prior to the strike year of 1993.

Coal production in Illinois in 1993 specifically amounted to 42.1 million tons, a drop of 18.5 million tons from 1992, or a decrease of more than 30 percent. The impact of the seven-month strike by the United Mine Workers of America against the Bituminous Coal Operators Association was substantial, affecting more than 3,700 miners at 19 Illinois mines.

In addition, the record-breaking floods of 1993 contributed to delays in coal deliveries, with many barge and rail transportation routes closed due to rampaging rivers flowing out of their banks.

The Board predicts that Illinois coal consumption by utilities will drop by 11 million tons from 1990 levels to 43.2 millions tons in 1995 (some 40.2 million tons were purchased by utilities in the strike year of 1993). Total utility consumption is predicted to be less than 33 million tons by the year 2000.

Of 33 electric generating stations burning Illinois coal in 1993 that are affected by the Phase I mandate, 66 percent have indicated they will



"Some recovery is projected for Illinois coal after 2000 in response to anticipated growth in coal-fired electric generation...."

- Illinois Coal Development Board

switch to low-sulfur coal, with just one-sixth of those plants choosing to burn high-sulfur Illinois coal. Approximately 11 percent will use energy allowances purchased on the open market, and an additional 11 percent will opt for scrubbers.

Some recovery is projected for Illinois coal after 2000 in response to anticipated growth in coal-fired electric generation in the central and eastern United States. In the meantime, however, the report states that the Illinois coal industry "will need some form of preferential treatment by the state if it is to bridge the gap." Even then, says

f Phase I-Affected n the Illinois Coal Market

%

%

%

22%

33%

te: Categories are not mutually exclusive.

e report, "clean coal technologies must sufficiently demonstrated and ready r commercial development by 2000."

The report notes that the Climate ange Action Plan signed by Presint Clinton in 1993 is committed to ducing greenhouse gas emissions by 00. Since that plan promotes the use of natural gas, hydroelectric and renewables over coal, it is likely to adversely impact Illinois coal utilization in the next decade.

However, the potential clean coal technology market for new facilities and retrofit installations in foreign countries could amount to between $570 billion and $870 billion by the year 2010, particularly in China, South Asia and Pacific Rim nations.

At the end of 1993, nearly 7,400 miners were employed by the Illinois coal industry – a significant decline from the 10,100 miners employed in 1990. With the anticipated loss in production in the near future will come a decrease to 7,200 Illinois coal miners in 1995 and 5,700 miners by 2000. Resulting non-mining job losses from 1992 employment levels are expected to amount to 8,100 in 1995 and 15,500 by the year 2000. Also, statewide personal income will drop from 1992 levels by $420 million in 1995 and by $805 million in 2000.

In its report, the Board identifies strategies to preserve existing markets for Illinois coal, to develop new markets and uses for high-sulfur coal and to minimize the adverse impact of national economic and environmental policies on the Illinois coal industry and its workers.

For example, the Board suggests a tax credit program that shares with coal purchasers the state's revenue benefits associated with preventing coal production losses.

Also cited as progressive pursuits are ENR's Coal Education Program, which is aimed primarily at children to foster awareness and understanding of coal, and an expansion of ENR's scope of coal research, development and demonstration programs.

The Board urges the ICC to consider whether or not socioeconomic effects, as well as environmental externalities should be incorporated into energy resource planning.

CCT Coalition Advocates Uses of Clean Coal

Recently, we interviewed Ben Yamagata, executive director of the Clean Coal Technology Coalition in Washington, D.C. The Coalition is an ad hoc group of entities, including electric utilities, coal companies, architectural and engineering firms, construction companies, equipment suppliers, state governments and universities. The Coalition is committed to the development, demonstration and widespread use of emerging clean coal technologies and strongly supports the U.S. Department of Energy's clean coal technology program.

Q: What is the mission of the Clean Coal Technology Coalition?

A: Basically, we advocate commercial development and widespread use of clean coal technologies (CCTs) in every forum that will further those goals. That includes personal meetings with decision-makers in Congress and the Clinton administration and their respective staffs. We also send mailings, write articles, give speeches and present our cause in appropriate ways.

Q: Do you think legislators now fully understand the impact of clean coal technologies?

A: I do think most legislators understand the impact of CCTs. Of course, some understand better than others. Our message to policy-makers is that coal is the number one long-term stable domestic fuel in the

"Our message to policy-makers is that coal is the number one long-term stable domestic fuel in the United States."

- Ben Yamagata

United States. Essentially, our country is the "Saudi Arabia of coal." Most people understand and agree that we have a great resource, but we must use it cleanly and efficiently.

However, as we all know, there are several programs competing for federal money. We have very important and solid reasons to receive some of that money, but so do several other groups. Another concern is that our program is considered very mature; it started in 1988. In addition, government and industry had been researching clean coal technologies long before that. Sometimes we have legislators who ask, "Hasn't this research done what it's supposed to do? Why do you need more money?"

It's our job to help policy-makers understand the importance of our goals and missions when they are deciding allocation of funds between programs.

Q: How do you respond when legislators ask why do you need more money?

A: The U.S. Department of Energy (DOE) recently put out a report titled "Clean Coal Technology: The Investment Pays Off." This has been helpful in explaining to legislators what has been accomplished to date in CCT programs, such as the commercial development and the sale of some technologies.

We have also gained a great deal of knowledge through research. We explain that with this knowledge, clean coal technology has taken a new direction. Before, the focus was on retrofitting old equipment in order to capture harmful emission. Now, the industry is going forward by creating new technology that deals with combustion conversion, which is a very advanced method of clean coal technology.

Ben Yamagata, Executive Director of the Clean Coal Technology Coalition based in Washington D.C.

Q: Can you tell us what part the Clean Coal Technology Coalition has in shaping and implementing DOE's Clean Coal Program?

A: As a coalition advocacy group, we pay strong attention to the DOE Clean Coal Program. They too are advocates for funding and they do a good job of watching what is going on in the area of CCT research on the state level. But we are separate entities.

We are a membership dues organization and they are, obviously, a government program. They do not support any one particular group. Officials at the DOE Clean Coal Program are very kind in seeking our input on issues, but there are times that we disagree. For the most part, however, our goals are closely aligned.

Q: What are your suggestions for moving clean coal technology demonstration projects into the domestic marketplace?

A: Our recommendation before DOE and Congress is to use any funds remaining in the national clean coal program to help support commercialization of clean coal facilities. Congress has appropriated $2.7 billion over a 15-year period, beginning in 1986, to 45 clean coal technology research projects. Out of these 45 projects, it is possible that some of them will not advance enough to use the money planned. We think this money can support commercialization.

Other organizations, such as the National Coal Council, advocate increased government funds for commercialization. Some people believe that utilities and private industry should pick up the tab. We certainly think that utility companies should be involved in the commercialization of technology as much as possible, but realistically they are not going to take great risks. Utilities are historically adverse to risk to begin with, and today there are more demands than ever on them. It is difficult to assure they'll fund the commercialization of a technology once it's demonstrated.

Our recommendation makes sense. We're not asking the government for more money and we're not asking private industry to take on too much risk. We think that there is enough money available, already earmarked for CCTs, that can take this technology to the commercialization level.

Q: What criteria would you recommend using when choosing which CCT projects to market for commercial use?

A: We advocate a formula basis. However, we are not in the business of choosing technology and feel confident that the free marketplace system will decide for itself which technologies are acceptable and which are not. ✦

"Since the spring of 1993, we have seen several encouraging developments in clean coal technology work in Illinois."

- Kim Underwood

Illinois' Coal Industry Braces for '95 Slowdown

**By Kim Underwood, Director,
Office of Coal Development and Marketing
Illinois Department of
Energy and Natural Resources**

We've seen it coming for nearly four years. And now it's almost here.

From the moment the Clean Air Act amendments were signed into law in November 1990, the Illinois coal industry has kept a wary eye on the date of January 1, 1995: The beginning of Phase I of the Clean Air Act amendments. The beginning of mandated sulfur dioxide emission reductions. The official beginning of tough times for Illinois and high-sulfur coal.

I say "official," because while we've been working very hard for many years to find ways to make Illinois' abundant high-sulfur coal into fuel that can be used in environmentally sound and economically efficient ways, a number of public utilities have already made compliance decisions.

Those decisions, in many cases, have not been favorable to us. As the 1994 Illinois Coal Development Board Report points out, 33 of 67 electric generating stations – virtually half – that burned Illinois coal in 1993 have units that are affected by the Phase I mandate. Just 11 of those 33 plants, or 33 percent, have opted for compliance choices that can be viewed as somewhat favorable to Illinois' coal industry.

Kim Underwood

Those 11 plants will split their choices between options of switching to low-sulfur Illinois coal, utilizing existing technologies or purchasing allowance credits on the emissions market.

What we are seeing, however, is an erosion of significant proportion in the purchase of Illinois high-sulfur coal.

In fact, the total of 42.1 million tons produced in 1993, caused in great part by the seven-month strike of the United Mine Workers of America against the Bituminous Coal Operators Association, is a fairly representative figure for what we can expect as an annual amount to be produced in our state for the next several years.

The Coal Development Board Report, compiled annually for Governor Edgar and the Illinois General Assembly, presents several valid scenarios for helping keep coal an important industry in this state and for our economy.

Recommended as supportive to the long-term viability of our industry are measures such as extending the sunset date to 2005 for income tax credits for coal research and coal utilization equipment, promoting the use of Illinois coal and expanding and accelerating the state's successful Coal Education Program.

While all of these areas merit considerable attention, we should take heart in the progress that has been made in another area cited by the report: the research, development and demonstration of coal programs. Since the spring of 1993, we have seen several encouraging developments in clean coal technology work in Illinois.

In March 1993 a micronized coal project was unveiled by Rochelle Municipal Utilities at Rochelle, Illinois.

During Coal Awareness Week in October 1993 we saw the unveiling of the Tecogen coal/water slurry system at the Illinois Coal Development Park (ICDP) in Carterville.

In April of this year we were delighted to participate at the ICDP in the long-anticipated groundbreaking for the MILDGAS process developed by the Institute of Gas Technology.

Meanwhile, another project of substantial impact for Illinois' coal industry makes giant inroads at PSI Energy's Wabsh River power plant in West Terre Haute, Indiana. The integrated gasification combined-cycle (IGCC) process, designed by Destec Energy, Inc., utilizes a coal/water slurry, an oxygen-blown, two-stage, entrained-glow gasifier and an advanced gas turbine that can burn coal-derived fuel gas. The project repowers one of six existing steam turbines at the station for a net unit generation of 262 megawatts.

Sulfur dioxide emissions are being reduced by 98 percent, and with an eye on Phase II mandates for the year 2000, nitrogen oxide emissions are reduced by 90 percent. All of this is accomplished with high-sulfur, Illinois Basin bituminous coal at a rate of 2,544 tons per day.

The point about all of the processes listed above is that the blood, sweat and tears devoted to clean coal technology efforts in Illinois and elsewhere in the country will pay off in the long term when we see the return of coal-generated power in full form.

Illinois Department of Energy and Natural Resources
Office of Coal Development and Marketing
325 West Adams, Room 300
Springfield, IL 62704-1892

Illinois Coal Update

Illinois Department of Energy and Natural Resources
Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing
John S. Moore, Director; Jim Edgar, Governor

- **Groundbreaking for ICDP Project**
  Three years of preparation have come to an end as a groundbreaking ceremony was held to officially begin construction of the MILDGAS project at the ICDP.
- **1994 Coal Board Recommends Market Strategies**
  The Illinois Coal Development Board's 1994 Report "Outlook for the Illinois Coal Industry" suggests several plans for the future of Illinois' coal markets.
- **Q & A**
  Ben Yamagata, Executive Director of the Clean Coal Technology Coalition discusses clean coal technology.

Printed by Authority of the State of Illinois.
Printed on recycled and recyclable paper.
X0000AA - 10M - 6/94

Illinois Coal Update

ILENR/CD-90/02(95-1)

ENR Illinois Department of Energy and Natural Resources

Volume 6, Number 1 1995

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

Coal Board Gives Approval for Low Emission Boiler

An innovative Low Emission coal-fired Boiler System (LEBS) was one of three clean coal technology projects to receive approval for funding from the Illinois Coal Development Board at its October meeting. The project, to be implemented in four phases, is a portion of the U.S. Department of Energy's (USDOE) Combustion 2000 program.

The copper oxide process was developed by Sargent & Lundy. The prime contractor is the Riley Stoker Corporation, with support from Textron Defense Systems, Tecogen, Inc. and Reaction Engineering International.

Recently completed, Phase I of the project includes development of a 50-megawatt Proof-of-Concept (POC) facility design and an additional design of a 400-megawatt plant.

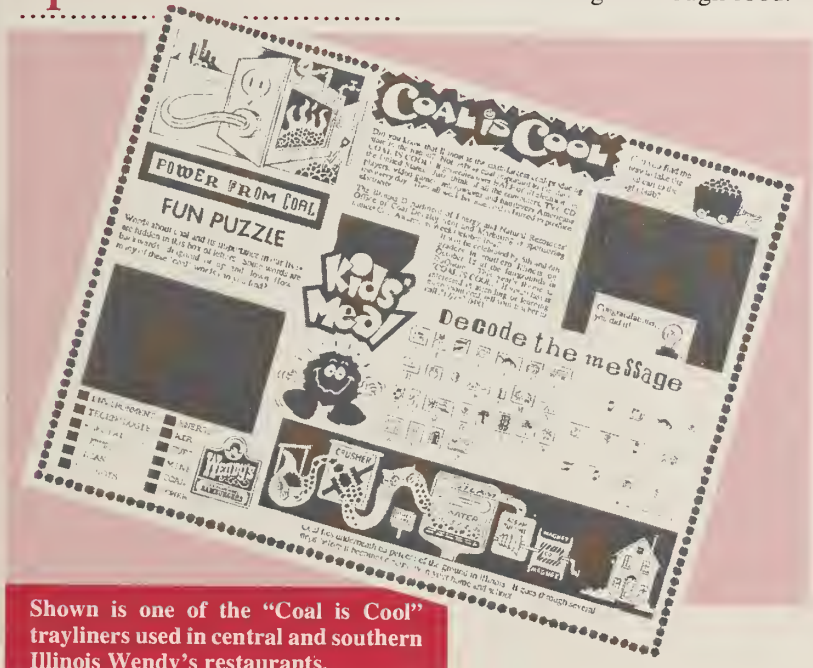
Phase II and III, which have been budgeted at $12.7 million, will include approximately 39 weeks of research testing at the Illinois Coal Development Park in Carterville. Data gathered from the testing will permit completion of designs for a nominal 400-megawatt plant using Illinois coal as its design-basis fuel. If successful, Phase IV will involve the POC unit which could consume between 150,000 tons and 200,000 tons of Illinois coal each year.

With a reduction of sulfur dioxide by 97 percent expected, Richard Shockley, director of the Illinois Clean Coal Institute at the Coal Park, sees great potential for the high-sulfur coal industry in the LEBS project. "Successful operation of the LEBS could greatly assist the market for Illinois coal," says Shockley. "We believe that the development of this and other clean coal technologies will ultimately result in renewed interest in high-sulfur coal."

In addition, an efficiency goal of 40 percent to 42 percent with high-sulfur coal is projected, as compared with 33 percent to 35 percent efficiency for conventional coal-fired plants. This project will foster the next generation of coal fired plants. ✦

Wendy's Serves Up "Cool" Coal

The Illinois Department of Energy and Natural Resources' Office of Coal Development and Marketing (OCDM) is always looking for ways to reach Illinois schoolchildren with information about the state's coal industry. In October, OCDM learned that one way to stimulate their thinking is through food.



Shown is one of the "Coal is Cool" trayliners used in central and southern Illinois Wendy's restaurants.

OCDM worked with Wendy's restaurants throughout central and southern Illinois on a "Coal Is Cool" placemat program. Patterned after the familiar "fun-pack" trayliners used with kids' meals at fast-food restaurants, OCDM put together a number of useful facts about Illinois' coal industry. The trayliner featured lively cartoon drawings with coal themes, coal versions of popular children's mazes, decoder messages and word boxes. "Our franchisers were quite happy with the coal trayliners," said Victoria Kamen, field marketing manager for Wendy's in Illinois. Nearly 400,000 trayliners were distributed through Wendy's restaurants in central and southern Illinois.

"The calendar is informative, and people enjoy the colorful drawings created by talented young artists throughout the state."

- Kim Underwood

Illinois' 1995 Coal Calendars Now Available

Educating Illinois' schoolchildren about the importance of the state's coal industry is a top priority for the Illinois Department of Energy and Natural Resources' Office of Coal Development and Marketing (OCDM). One of the most gratifying elements of OCDM's program is selecting winners in the state's annual contest "Words and Pictures About Illinois Coal."

Sponsored by OCDM and Southern Illinois University at Carbondale's Coal Research Center, the contest draws hundreds of entries from throughout the state. The 12 winning essays for the 1995 contest were chosen by SIUC's Coal Research Center and the 13 pieces of prize-winning original artwork were selected by OCDM. All of the winning entries are featured in the 1995 "Words and Pictures About Illinois Coal" calendar.

"The calendar," says Kim Underwood, director of OCDM, "is informative, and people enjoy the colorful drawings created by talented young artists throughout the state."

Several winners in the "Words and Pictures about Illinois Coal" art and essay contest pose with the calendars and their certificates at Coal Awareness activities in DuQuoin.

Created for 5th and 6th grade students, the contest centers on th theme "Energy and the Environment Children submit an essay or artwor

Coal Awareness Month '94 is a Hit in Three Cities

Inaugurated in 1989, Coal Awareness Month has become an all encompassing coal education program. "Coal is Cool" was the theme celebrated during last October. More than 9,000 Illinois schoolchildren participated in the activities held in Springfield, DuQuoin and Chicago. Displays such as a Coal Miners' Memorial, a wetlands exhibit, mine models, and rock and mineral collections captivated the schoolchildren.

"We are delighted that so many Illinois schoolchildren were provided with such unique learning experiences from a variety of informative sources," said Kim Underwood, director of ENR's Office of Coal Development and Marketing. "Through the various exhibits on display during Coal Awareness Month, children and adults could see for themselves how Illinois coal will provide an environmentally sound and economically efficient answer to the energy needs of the future."

Illinois schoolchildren view a coal display at Coal Awareness activities at the Illinois State Fairgrounds in Springfield.

Coal Awareness Month activities are free, open to the public, and sponsored by the Illinois Department of Energy and Natural Resources (ENR) in conjunction with the Illinois Clean Coal Institute. ✦

"(The system) has been designed to operate with the same level of ease and reliability as a conventional oil-fired system."

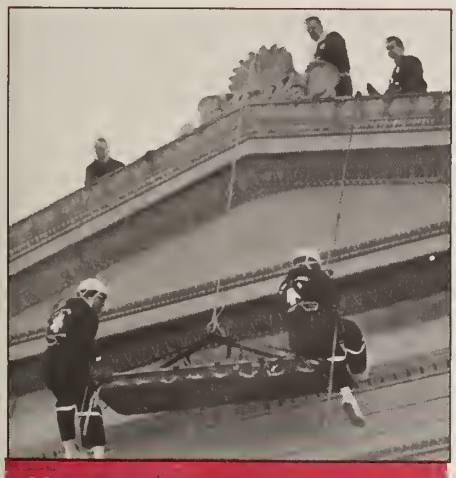
- Frederick E. Becker

that portrays the significance of coal to the state of Illinois and its relationship to energy and the environment.

"Selecting winners in the annual coal art and essay contest is always a pleasant but difficult task," says Underwood. "Entries from through out Illinois demonstrate that these children understand the importance of coal to our state, not just economically but in providing a reliable and environmentally sound energy source as well."

A limited number of copies are available and can be ordered by writing the Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing, 325 West Adams, Room 300, Springfield, Illinois 62704-1892, or calling 217-782-6370.

Illinois residents can call ENR's Information Clearinghouse toll-free at 1-800-252-8955. TDD customers may call 217-785-0211 or 1-800-526-0844. ✦



Members of the Mine Rescue Team from the Illinois Department of Mines and Minerals demonstrate life-saving skills during Coal Awareness activities at the Chicago Museum of Science and Industry.

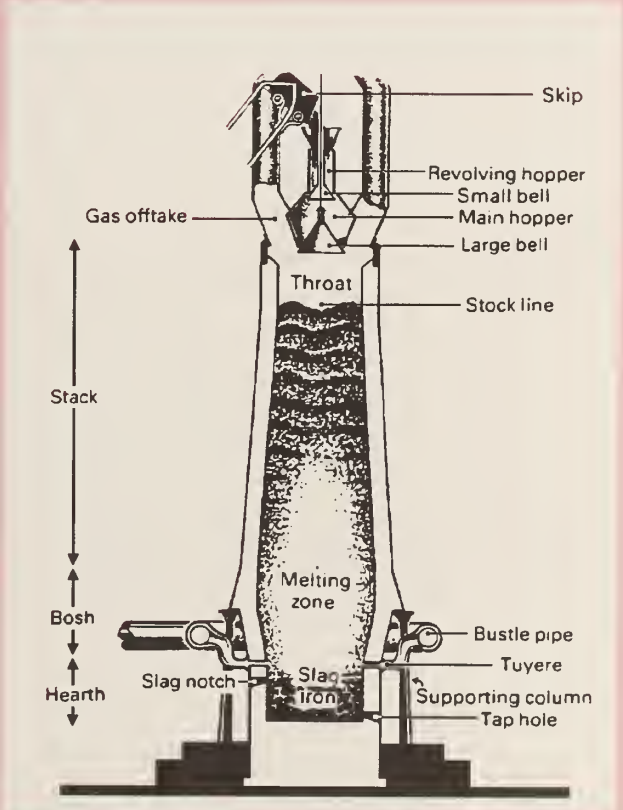
Technology Up Close: Tecogen Coal/Water Slurry

Finding ways to market Illinois' high-sulfur coal in the wake of the Clean Air Act Amendments of 1990 is vital to the survival of the state's coal industry. With Illinois' commitment to demonstrating new and innovative technologies, answers may be on the horizon.

The Tecogen commercial demonstration at the Illinois Coal Development Park (ICDP) at Carterville was unveiled during Coal Awareness Week in October 1993. The $2.5 million program budget was approved by the Illinois Coal Development Board and funded by the Illinois Department of Energy and Natural Resources and the U.S. Dept. of Energy's Pittsburgh Energy Technology Center.

"The Tecogen system is unique for two reasons," says Richard Shockley, director of the Illinois Clean Coal Institute (ICCI). "It uses a coal/water mixture that utilizes a patented combustor developed especially for high-sulfur coal use."

Called an IRIS (Inertial Reactor with Internal Separation) Combustor, it suspends the fuel slurry in swirling air to enable the fuel to burn more efficiently. The system has demonstrated the ability to burn more than 99 percent of fuel intake, maximizing the potential thermal efficiency while minimizing any residual fly ash.



Shown above is a cross section of a typical blast furnace. Note the location of the tuyeres around the base of the furnace (after Long 1968).

The system also reduces sulfur dioxide produced from combustion of coal. Using a sodium-based sorbent compound which is injected into the flue gas, sulfur can be removed by the same baghouse used

"It is critical that we do everything possible in the promotion of clean coal technologies to keep the coal industry viable in southern Illinois."

- Governor Jim Edgar

to capture any particulate matter.

Waste then clings to the baghouse's fabric filter while the gas passes through. Sulfur in the flue gas reacts with the sorbent and forms a dry compound, which together with coal ash comprises the sole waste product from the Tecogen process.

"The system is most unique," says Frederick E. Becker, director of energy technologies at Tecogen. "It has been designed to operate with the same level of ease and reliability as a conventional oil-fired system. All that is required is to press a single start-up button and the system goes into full operation."

Shockley says the Tecogen project at ICDP had three primary objectives. "The first was to study the viability of commercially producing a coal/water slurry to fire the combustor. Coal in liquid form is much easier to transport than in its conventional form, and makes coal more competitive with fuel oil or natural gas, standard sources of energy for industrial heating."

"A second objective," says Shockley, "was to observe and evaluate the Tecogen combustor on the basis of its fuel efficiency and capability of reducing emissions. And third, researchers examined how the Tecogen technology may open new industrial markets for Illinois high-sulfur coal."

A final report on the Tecogen project at ICDP has been submitted to the U.S. Department of Energy. ✦

Bill Extends Tax Credits to Year 2005

Governor Jim Edgar (R-Ill.) and the Illinois legislature have teamed up to provide continued tax incentives for coal research and pollution control equipment.

In September Governor Edgar signed House Bill 2349, which was sponsored by Sen. Ralph Dunn (R-DuQuoin) and Reps. Terry Deering (D-Nashville), Larry Woolard (D-Carterville) and Art Tenhouse (R-Quincy). The bill amended the Illinois Income Tax Act to extend tax credits an additional ten years to January 1, 2005. Tax credits of 20 percent are allowed for contributions to clean coal research and 5 percent for the purchase of pollution control equipment.

"Coal is one of Illinois' most abundant resources," said the Governor, during a signing ceremony at the Illinois Coal Development Park in Carterville. "It is critical that we do everything possible in the promotion of clean coal technologies to keep the coal industry viable in southern Illinois."

"These tax credits will be continued until 2005," added Edgar, "we hope that Illinois coal once again will regain its prominent role as an energy source. The jobs the coal industry provides are critical to the entire state. The importance of coal to Illinois cannot be understated."

The Illinois Department of Energy and Natural Resources and the Illinois Clean Coal Institute (ICCI) oversee state coal research and demonstration projects. Illinois is a national leader in the research, testing and demonstration of clean coal technology, designed to utilize high-sulfur coal in economically efficient and environmentally acceptable ways.

To date, nearly $1 billion in federal, state and private funds have been allocated toward demonstration of innovative clean coal technologies in Illinois. ✦

Illinois Governor Jim Edgar addressed supporters of the Illinois coal industry at the Illinois Coal Development Park. The bill-signing ceremony, which took place in September, extended coal research tax credits to the year 2005.

"The cost of coke is increasing as its availability decreases. In addition, the ovens used to produce it are expensive to build and costly to operate."

Dr. John C. Crelling

ICCI Funds a Coal Furnace Injection Study

We're all painfully aware of the adverse effects of the Clean Air Act on the Illinois coal industry. However, research is presently underway on a project that could actually demonstrate the benefits of high-sulfur and chlorine content in Illinois coal.

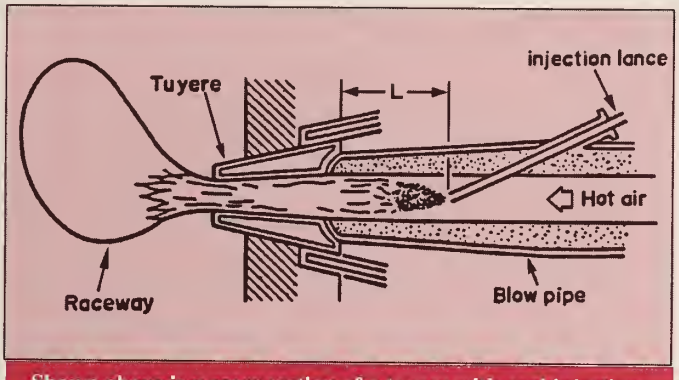
A study examining coal combustion under conditions of blast furnace injection is being researched by Dr. John C. Crelling, professor of geology at Southern Illinois University at Carbondale. Funded by the Illinois Clean Coal Institute (ICCI), Crelling's work is one of 33 basic and applied research projects that have received a total of $3.1 million from the ICCI, which is headquartered at the Illinois Coal Development Park (ICDP) in Carterville.

Crelling says that a potential new use for Illinois coal is as fuel injected into blast furnaces to produce molten iron for steel production. "Limited research to date," says Crelling, "has suggested that coals of low fluidity and moderate to high-sulfur and chlorine contents — such as a significant amount of Illinois coal — are suitable for blast furnace injection. We hope our research will further emphasize this use for high-sulfur coal."

"Replacing coke with coal in blast furnaces would be an economic benefit to the steel industry," says Crelling. "The cost of coke is increasing as its availability decreases. In addition, the ovens used to produce it are expensive to build and costly to operate."

Coal injection research in Europe and Japan has resulted in reduced demand for metallurgical coke, increased blast furnace efficiency and reduced operating costs. While there have been no problems at current rates of coal injection, complete combustion of injected coal is a problem for operation at greatly increased injection rates.

To date, research abroad has indicated that the characteristics of much of Illinois' coal may be quite suitable to this particular use. Low rank and low fluidity, for example, which have heretofore limited the use of Illinois bituminous coal as a coking coal, appear to be desirable for coal injection.



Shown above is a cross-section of a tuyere with coal injection.

Illinois coal's high chlorine may be an advantage in coal injection, since chlorine is commonly added to blast furnaces as calcium chloride to control alkalis such as sodium and potassium. Furthermore, sulfur in coal injectants has an increased tendency to enter the slag rather than the iron.

"Those are some of the reasons why we view this as an exciting technology," says Richard Shockley, director of the ICCI. "Properties generally considered negative in marketing Illinois coal are actually positive components in this situation."

The potential for business application of this technique is substantial. Eleven blast furnaces presently utilize coal injection or are about to come on-line. All are located in the Midwest and together could consume several million tons of coal per year.

With many steel mills located in northern Illinois and Indiana, transportation costs for Illinois coal are very reasonable and more competitive than high-sulfur coal from other parts of the country. Thus, the work at ICDP is being closely watched by the Illinois coal industry.

Crelling has received funding for a third year of research. Since last summer, he has been testing Illinois coals in a study for the Canadian Center for Mineral and Energy Technology in Ottawa, Canada.

The ICCI-funded study is the first effort in North America to directly determine the nature of coal combustion injected into a blast furnace. Crelling would like to see results of his research lead to the development of a testing and evaluation protocol, that will provide a unique understanding of the behavior of coal during accelerated injection. ✦

Illinois Department of Energy and Natural Resources
Office of Coal Development and Marketing
325 West Adams, Room 300
Springfield, IL 62704-1892

Illinois coal Update

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

- **Bill Extends Tax Credits to 2005**
  Governor Edgar signed legislation extending the Illinois Income Tax Act credits to January 1, 2005.
- **Technology Up Close: Tecogen Coal/Water Slurry**
  The Tecogen system uses a coal/water mixture that utilizes a patented combustor developed for high-sulfur coal.
- **Coal Awareness Month '94 is a Hit in Three Cities**
  More than 9,000 Illinois schoolchildren participated in coal activities around the state.

Printed by Authority of the State of Illinois.

Printed on recycled and recyclable paper.

X502801 - 10M - 2/95

Illinois Coal Update

ILENR/CD-90/02(95-2)

Illinois Department of Energy and Natural Resources

Volume 6, Number 2 1995

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

Coal Gasification Plant Offers Hope for Illinois Coal

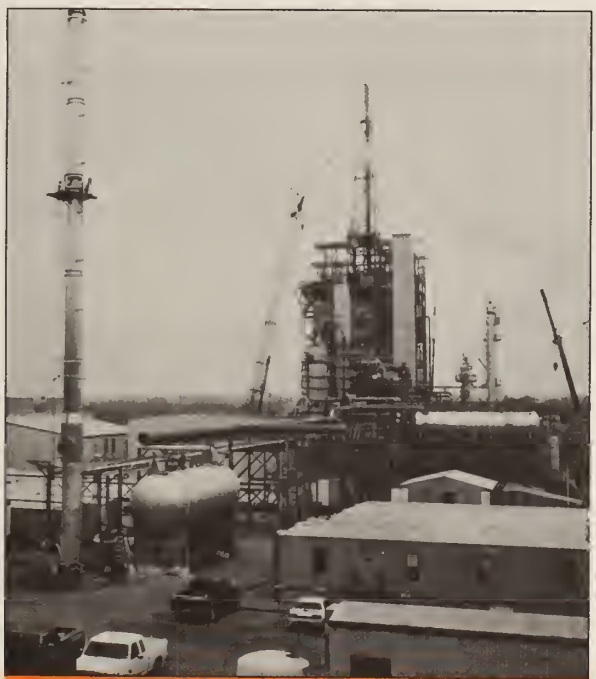
Progress continues unabated on a clean coal technology project that could mean good news for the high-sulfur coal industry in America.

Work has remained on schedule through April at the Wabash River Coal Gasification Repowering Project in Terre Haute, Indiana. Destec Energy, Inc., Public Service of Indiana (PSI) and the U.S. Department of Energy (DOE) have collaborated on a $590 million coal gasification plant scheduled to begin operation in August 1995.

Destec, a Houston-based subsidiary of Dow Chemical Company, and PSI, a public utility company serving parts of Indiana and Indiana's largest electric supplier, have been at work on construction of the facility since September 1993. Construction is due to be completed in June 1995, says Mark Roll, Destec market manager/coal gasification.

"We're going to have a commercial start-up date of August 15," says Roll. "Pre-start-up activity will occur throughout the summer, including the test firing of a gas turbine on No. 2 fuel oil." No. 2 fuel oil is the start-up fuel used before switching to syngas made from coal.

The coal gasification process begins with a coal slurry, a mixture of crushed coal and water. Prior to combustion, high-purity oxygen is injected together with the slurry into the gasified vessel and then heated to 2,600 degrees Fahrenheit. The partial combustion process gives off a gaseous mixture of hydrogen and carbon monoxide (the chemical energy in the syngas).



The Wabash River Coal Gasification Repowering Project, which will burn Illinois Basin high-sulfur coal, is scheduled to begin operation in August 1995.

The syngas then passes through particulate removal equipment which extracts unreacted carbon particles. Sulfur is also removed prior to combustion. The syngas is then burned in a gas boiler that turns a generator to produce electricity.

In addition to energy produced by syngas, the turbine's exhaust heat generates steam to drive a steam turbine. This double source of energy enables the coal gasification process to produce more power per pound of coal than is produced by simply burning the coal itself.

"Coal gasification is one of the promising clean coal technologies in development for future power generation that uses Illinois bituminous coal," says Dick Shockley, director of the Illinois Clean Coal Institute. This advanced process will help utility companies slash their emissions of sulfur dioxide and nitrogen oxide and meet the requirements of the Clean Air Act."

Initial construction on the project followed more than two years of negotiation, design work and regulatory filings. Upon completion, the Wabash River Repowering Project will represent the largest coal gasification combined-cycle power plant in operation. Even so, it will produce lower emissions than other large, high-sulfur coal-fired power plants.

"This will be one of the most efficient power plants in America," says Roll. The coal gasification project will replace one of the six coal-fired turbines at the Wabash River plant. Emissions from the repowered generating unit will be at least 90 percent lower than the original plant, despite an increase in electrical generating capacity of more than 150 percent. The combination of coal gas and steam will increase production at the repowered turbine from 85 megawatts of power to 262 megawatts.

Based on results at Destec's small coal-gasification demonstration plant in Louisiana, the process should produce sulfur dioxide

continued on Page 2

"The coal education kits are an excellent way for children to learn about the exciting new aspects of the coal industry in Illinois."

- Gary Philo

continued on Page 2

emissions of 0.02 pound and nitrogen oxide emissions of 0.08 pound per million Btus of coal. These levels are far below the Phase II requirements of the Clean Air Act of 1.2 pounds of sulfur dioxide and 0.6 pound of nitrogen oxide per million Btus.

By-products of the process include high-purity sulfur and a black sand-like material, both saleable commodities.

Roll says that No. 6 Illinois Basin coal will be used at the Wabash River plant, while Destec will supply fuel in the form of syngas steam to the PSI power plant.

The plant will consume 2,550 tons of coal per day, or 700,000 tons in a year. That's enough to keep a fair-sized mine operating, according to Shockley.

In August the coal gasification project at the Wabash River plant will begin a three-year demonstration phase of the CCT program with the U.S. Department of Energy contributing $220 million for the project, says Roll.

"After that," he adds, "we'll continue operating the plant commercially under a joint venture with PSI and Destec for another 22 years. We also have a provision to extend the operation an additional 10 years."

Plant facility investment by Destec, PSI and DOE is $380 million to repower one of the six existing boilers at the Wabash River plant.

The coal gasification project represents a "life extension strategy" for the Wabash River site, says Roll, because the plant was originally built in 1952. "This project also represents the first time that gasification has been applied in a fully commercial repowering of an existing coal-fired power plant," he adds. ✦

Coal Education Program Reaches Out to More Students

It has been said that the future of the world rests in the successful education of its children.

This fundamental philosophy is one of the driving forces behind the continued growth and expansion of the coal education program sponsored by the Illinois Department of Energy and Natural Resources' Office of Coal Development and Marketing (OCDM).

State officials often acknowledge that the continued success of the Illinois coal industry largely depends upon the rapid development and deployment of clean coal technologies, aggressive marketing efforts and continued research into alternative uses for Illinois high-sulfur coal. OCDM's coal education program endeavors to create a positive image for coal, inform and educate young children on issues important to the coal industry, and promote career opportunities within the coal industry as scientists, executives and policy makers.

The coal education program began in 1988 as a poster and essay contest titled "Words and Pictures About Illinois Coal." Created for 5th and 6th grade students throughoutIllinois, the contest continues to generate widespread interest. This year thirteen art and twelve essay entries were chosen from hundreds submitted by participating schoolchildren statewide. These winning posters and essays will be included in the 1996 calendar available this fall.

To broaden this education effort, a 5th- and 6th-grade coal education resource kit was developed in 1993. The kit consists of a five-part lesson plan for teachers designed to show students the social and economic importance of the coal industry to Illinois. Individual lesson plans cover interesting facts about coal, mining and mine safety, and discuss promising clean coal technologies and their role in meeting new clean air standards. Also included are posters, a coal calendar, coal samples and the award winning video "Kids, Coal and the Environment."

Due to the overwhelming success of the 5th- and 6th-grade kit, OCDM produced a coal education resource kit for educators of kindergarten through

2nd-grade students. This kit features games, word puzzles, and coloring pages containing information about coal and Illinois' mining industry. To date, more than 12,000 of the K-2 and 5th/6th-grade kits have been distributed to educators. With such a wide distribution, the coal education program could reach as many as 250,000 students this year alone.

"A number of hands-on, interactive panels will highlight clean coal technologies and explain their importance in addressing environmental issues."

- Ed McDonald

"The coal education kits are an excellent way for children to learn about the exciting new aspects of the coal industry in Illinois," says Gary Philo, manager of Coal Demonstration and Marketing at OCDM. "Today's coal industry utilizes many skills that children will acquire throughout their education careers, including math, vocabulary, spelling and science. The coal education kits bring together those educational principles in lessons on Illinois' abundant coal resources and those industries involved in coal extraction, distribution and utilization."

In response to the wide interest in additional educational materials on coal, a 3rd- and 4th-grade education kit is currently being developed. The activities in this kit will provide an integrated approach to incorporating one of Illinois' most important resources—coal—into the curriculum.

Long-range plans call for a coal education resource kit for junior high students which will emphasize the social, economic and environmental impacts of the coal industry on Illinois, as well as a kit for high school students and an experiment kit for high school chemistry teachers.

"With the coal education kits and other educational materials developed by OCDM, teachers across Illinois are changing the image of coal," says Philo. "Our youth are learning that energy from coal is fundamental to our day-to-day activities at work and in the home. Moreover, advanced technologies that are utilized by today's electric industry enable us to use coal in efficient and environmentally sound ways. We believe these lessons will be retained throughout their lives." ✦

Museum's Coal Exhibit Upgrade Planned for May

What exhibit first comes to mind when you think of the Chicago Museum of Science and Industry? Submarines? Aircraft? Historic trains? Giant displays of the human heart or the human brain? The new "AIDS: The War Within" exhibit?

How about coal?

According to marketing surveys taken for the Museum of Science and Industry in December 1994, the top response of all people surveyed was that the museum's venerable coal mine exhibit is the first thing that comes to mind when the Museum is mentioned to them.

For the first time since its inception in 1933, the coal exhibit is undergoing a facelift, with completion planned just in time for this year's busy summer season.

More that 600,000 people annually visit the exhibit while at the Museum. Plans for the upgrading were first unveiled in October 1994 as part of Coal Awareness Month festivities.

Visitors will notice many exciting changes at the renovated exhibit, says Ed McDonald, Museum manager of education and curriculum development. "We are finalizing the contents of a video that will be shown to people in the queuing lines as they await entry to the display," he says. "The video monitors will play training and mining information tapes giving people facts about various types of mining."

Mine rescue equipment will be on display at the exit of the mine. Another new feature, says McDonald, will be a simulated coal lamination on the outside of the mine. "The lamination," says McDonald, "will provide the effect of a three-dimensional view of a coal seam."

"We also replicated graphics from an earlier coal mine era," adds McDonald, "to place around the hoist area leading to the cage." Another significant change is the exit area of the exhibit, which has been transformed. "The Museum is planning on putting lighted panels with printed copy in that location," he says. "A number of hands-on, interactive panels will highlight clean coal technologies and explain their importance in addressing environmental issues."

Beyond the visual elements, state-of-the-art sound effects of machinery used in a modern coal mine were installed throughout the exhibit site.

Funding for the exhibit upgrade comes from a grant made by the Illinois Coal Development Board. In addition, says McDonald, a number of companies doing business with the coal industry are looking at ways to contribute to the exhibit with donations of money, equipment or coal-related materials.

"We are excited about the new improvements to the popular coal mine exhibit," says Sheridan Turner, Museum director of education. "We believe it is important that children and adults alike understand the science education behind energy resources."

The Museum of Science and Industry is the pre-eminent center for informal science education in the nation, attracting nearly two million visitors annually. Located at 57th Street and Lake Shore Drive in Chicago, the Museum is open Saturday through Thursday 9:30 a.m. to 5:30 p.m. and Friday 9:30 a.m. to 7 p.m. during the summer. For more information call 312-684-1414 or outside Chicago 1-800-GO-TO-MSI (1-800-468-6674). ✦

Technology Up Close: Micronized Coal Testing Yields Good Results

A two-year testing program at Rochelle Municipal Utilities in northern Illinois has yielded promising results in the burning of "micronized" coal.

Significant reduction in emissions of sulfur dioxide, nitrogen oxide, carbon dioxide and particulates all occurred when the Rochelle public utility power plant burned micronized coal from March 1993 through December 1994. Such results could help in the long-term outlook for the Illinois high-sulfur coal industry if micronized coal becomes a fuel of choice for utilities.

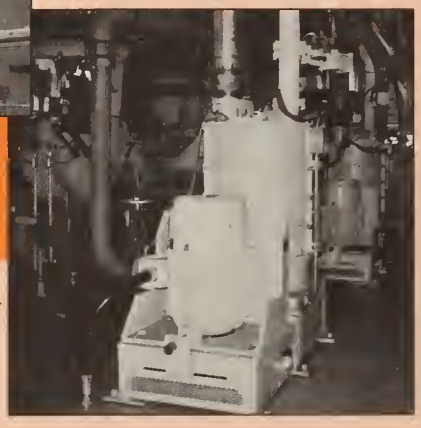
The micronized coal project at Rochelle Municipal Utilities yielded promising results in a two-year testing program completed at the end of 1994.

The $18 million clean coal technology project was partially funded by a $3.6 million grant from the Illinois Department of Energy and Natural Resources. Additional funding was provided by Rochelle Municipal Utilities, Peabody Coal Company and TCS, Inc.

A final report, titled "Status and Significance of Rochelle Municipal Utilities Micronized Coal-Fired Program," outlined in detail the results obtained from two years of testing at Rochelle. The report was prepared for the Illinois Office of Coal Development and Marketing.

The Rochelle plant has been operating since 1962. Originally designed as a dual-fuel burner, it was converted to the use of natural gas alone in 1988 as an interim measure until an appropriate technological, environmental and economical way could be found to once again burn Illinois high-sulfur coal. The micronized coal process achieves these objectives at the Rochelle plant.

Coal is micronized by pulverizing it to the consistency of talcum powder. Because of its extremely fine particle size — about one-half the diameter of human hair — micronized coal can combust efficiently, significantly reducing air emissions and producing a waste by-product that has useful market potential.



TCS, Inc. of Oakland, Maryland developed the micronized coal technology. Although coal micronization has been used on a smaller scale since 1980 at more than 90 TCS mills commercially installed for industrial application, Rochelle marked its first demonstration as a fuel source for electrical generation by a utility.

Micronized coal has three times the surface area of conventional pulverized coal, which allows for faster combustion and heat liberation and more uniform heat distribution.

The project at Rochelle involved combining micronized coal with micronized limestone to capture sulfur dioxide emissions. Micronized limestone acts as a flame temperature retardant that, when combined with coal, makes a "cool" flame that reduces emissions.

"We tested a total of five different limestones at Rochelle," said Tim Lanager, president of TCS. "Our goal throughout the testing period was to achieve a 50 percent reduction in sulfur dioxide emissions. That goal was met."

The limestones used in the Rochelle demonstration were from Illinois and were tested between July 1993 and December 1994. In addition to the 50 percent reduction in sulfur dioxide, results indicated that a 40 percent reduction was achieved in emissions of nitrogen oxide. Also, there was an 87 percent reduction in particulate emissions, while carbon dioxide emissions were reduced by more than one-fourth.

Beyond the substantial reductions in emissions of major air pollutants, micronized coal offers another benefit: micronized coal ash by-product can be used as a feedstock for cement manufacturing. The extremely fine particle size distribution of micronized coal ash enhances its ability to produce premium priced, "super-strength" concrete.

Lanager says that the success of the Rochelle project has enabled TCS to work on a heating plant for a state of Pennsylvania prison that will be the world's first newly created micronized coal plant. The $7 million heating project is scheduled for start-up in late spring 1996. TCS is also working on some micronized coal projects in Poland, the Czech Republic and Colombia. ✦

"Our hope for this research is to create a feasible use for these coal combustion by-products,"

- Dick Shockley

Coal Researchers Want "Concrete" Solutions

Researchers at Southern Illinois University at Carbondale (SIUC) are hoping that their efforts to find uses for coal by-products will help "pave the way" to the future.

Work has been underway for several years to determine if fly ash and bottom ash — two common coal combustion by-products — have useful application as concrete that can be used in roads and highways.

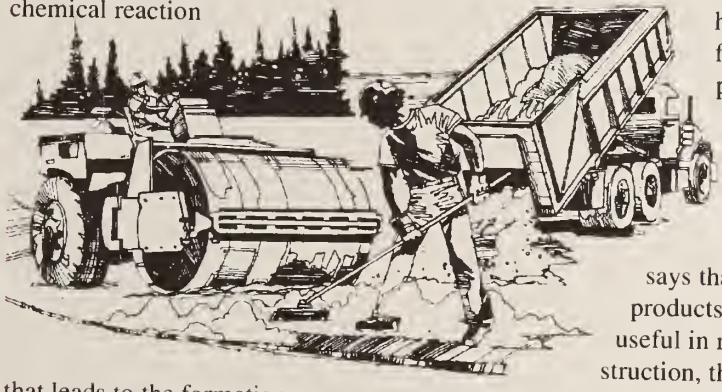
Researchers have been working under a grant from the Illinois Clean Coal Institute (ICCI), which each year allocates funds to selected scientists and institutions based upon specific criteria. Projects are chosen in seven different areas: coal related waste management, coal conversion, combustion, gas cleanup, coal cleaning, coal characterization, and coal related studies. The ICCI is the research arm of the Illinois Office of Coal Development and Marketing.

In 1991 coal researchers at SIUC began a two-year laboratory investigation into potential positive uses for fly ash and bottom ash. Following successful completion of laboratory testing, the project was moved to its demonstration phase at the Illinois Coal Development Park (ICDP), in Carterville, a few miles east of the SIUC campus.

Twenty-three concrete slabs, each measuring 6 feet wide, 12 feet long and at least 8 inches thick, have been placed together to form an experimental one-lane road inside the ICDP. The slabs contain varying mixtures of limestone, fly ash and bottom ash and routinely are subjected to the daily stress caused by traffic and weather.

Dr. Nader Ghafoori, associate professor of civil engineering and mechanics at SIUC, understands the significance of the outdoor demonstration. "We have simulated the effects of weather and traffic in the laboratory," he says. "Now these experiments will evaluate the true effects of environment on an actual concrete road surface."

The experimental concrete is composed of 60 percent natural aggregate material and 40 percent by-product ash. Mixing the two different types of ash, fly ash and bottom ash, with water creates a chemical reaction



that leads to the formation of a cementitious mixture, says Ghafoori, which hardens over time.

Testing at the Illinois Coal Development Park has indicated that the experimental concrete actually forms a less porous finished surface than conventional concrete. This may be of great significance, since many cracks and potholes in concrete roads are created when water expands following periods of freezing weather conditions.

"Our hope for this research is to create a feasible use for these coal combustion by-products," says Dick Shockley, director of the Illinois Clean Coal Institute. "Using fly ash and bottom ash for construction of roads is not only economically feasible but environmentally sound as well." This type of application could create a commercial market for the by-product materials.

By-products used in the experiment are generated by fluidized bed combustion and pulverized coal combustion which generate bottom ash and fly ash.

Because they represent combustion techniques commonly used by utility companies throughout the Midwest for the generation of electrical power, the market potential for Ghafoori's research is sizable. Presently, both types of ash are commonly hauled away from power plants to appropriate landfill disposal sites. Ghafoori says that if the by-products prove useful in road construction, they may have other applications as well in additional building and construction materials.

"We have been pleased by information revealed with this research to date," says Ghafoori. "It is our hope that these efforts will pay off by opening up new markets for coal waste by-products in ways that are environmentally beneficial. That could mean good news for the Illinois coal industry." ✦

Illinois Department of Energy and Natural Resources
Office of Coal Development and Marketing
325 West Adams, Room 300
Springfield, IL 62704-1892

Illinois Coal Update

Illinois Department of Energy and Natural Resources, Office of Coal Development and Marketing John S. Moore, Director; Jim Edgar, Governor

- **Coal Gasification Offers Hope for Illinois Coal**
  Illinois bituminous coal will be used in promising clean coal technology for future power generation.
- **Coal Education Reaches Illinois Students**
  With the wide distribution of the K-2 and the 5th/6th-grade kits, the coal education program could reach as many as 250,000 students.
- **Coal Exhibit at Museum to Receive Upgrade**
  The most popular exhibit at the Chicago Museum of Science and Industry receives a facelift for summer.

Printed by Authority of the State of Illinois.
Printed on recycled and recyclable paper.
X502801 - 10M - 5/95